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THE MOTOR INDUSTRY

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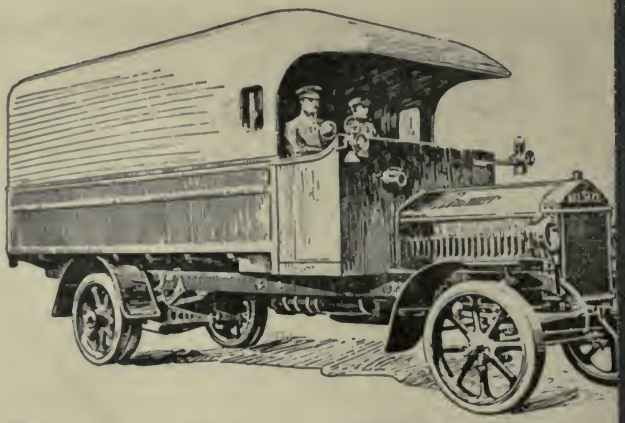

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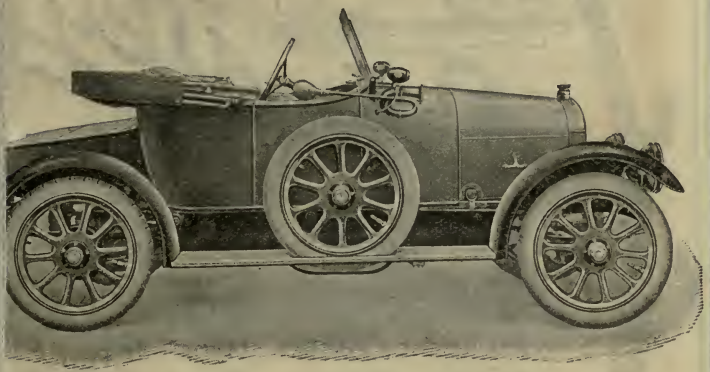

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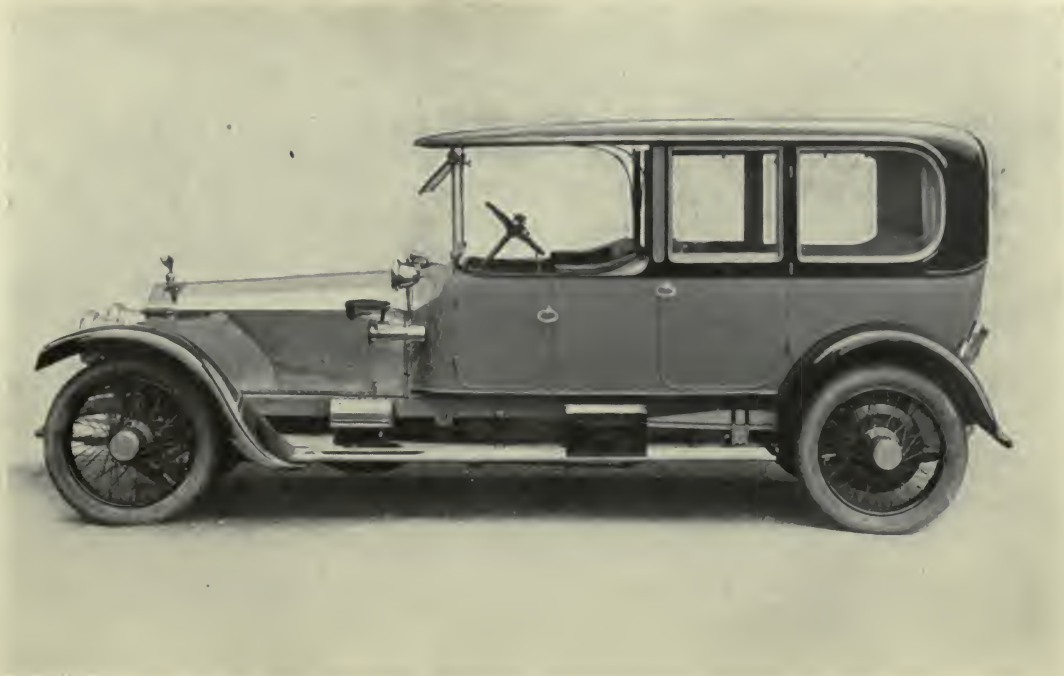

Frontispiece.

The Six-cylinder Rolls-Royce

A CAR DE LUXE

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PITMAN'S COMMON COMMODITIES
AND INDUSTRIES

THE MOTOR INDUSTRY

ITS GROWTH, ITS METHODS, ITS PROSPECTS, AND ITS PRODUCTS; WITH AN INDICATION OF THE USES TO WHICH MOTOR VEHICLES OF ALL KINDS ARE, OR COULD BE, ADVANTAGEOUSLY APPLIED

BY

HORACE WYATT, B.A.

HON. SECRETARY OF THE IMPERIAL MOTOR TRANSPORT COUNCIL, ETC.

190425
24.7.24

LONDON
SIR ISAAC PITMAN & SONS, LTD., 1 AMEN CORNER, E.C.4
BATH, NEW YORK AND MELBOURNE

Printed by Sir Isaac Pitman
& Sons, Ltd., London, Bath,
New York and Melbourne

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THE MOTOR INDUSTRY

CHAPTER I

THE YOUTH AND GROWTH OF THE INDUSTRY

THE motor industry is in certain respects unique. Its development has been extraordinarily rapid, and in view of its extreme youth, the degree of importance to which it has now attained is truly remarkable.

According to Sir David Salomons, who was one of the principal pioneers, the industry may be said to have been born in France in the year 1894. It was not until 14th November, 1896, that the Act, which limited the speed of motor vehicles travelling on British roads to four miles an hour, was repealed. Until that date, the law required every car to be preceded by a man on foot carrying a red flag. From these facts we see that the location of the industry in its early days was largely influenced by legislative restrictions. In those countries which first realised the potentialities of motor transport, the young industry had its earliest chances of development. It was principally for such reasons that France so long predominated in the manufacture of private motor cars, and continues up to the present day to hold a position second to none in respect of the production of cars of high quality. In framing schemes of taxation, and even in such trifling matters as the adoption of local by-laws, legislators—great and small—are apt

to disregard the effect that their actions may have on some essential industry. When Dublin alone among the capitals of Europe, with the sole exception of Constantinople, refused to license motor cabs to ply for hire, it is probable that the worthy citizens who sought thereby to protect the vested interests of the old jarvey, were quite blind to the far more vital consequences which would have ensued if their action had been generally endorsed. The same must be said of certain municipalities which have opposed the introduction of motor omnibuses, because they saw in these vehicles merely a possible antagonist to the established tramway system. Some of the worst examples of obstructive legislation have been found in certain British Colonies, among which Ceylon and Bermuda have attained unenviable notoriety.

In Great Britain, the development of the industry, while not entirely negatived, has been perpetually hampered by petty interference. The Motor Car Acts, framed to protect the public against a possible danger, have been more often used as a means of bringing funds into the local exchequers. The ratepayers have provided police who have often been employed mainly to detect those same ratepayers in the commission of purely technical offences. The law, which has prescribed a maximum speed limit of twenty miles an hour, has been totally ineffective except as an annoyance. There is probably not a motorist living in Great Britain, including those who took part in the framing of the law in question, who has not broken that law on almost every occasion upon which he has used his car.

Another example of obstructive legislation is to be found in the tendency to tax the fuel of the motor vehicle, though this may perhaps be justified if the tax be imposed with the agreement of the motoring

The Earliest Crossley Car

The Present Model

AN EXAMPLE OF PROGRESS

community, and the proceeds definitely earmarked to go to the improvement of the roads. Then again, laws devised for the admirable purposes of preventing gross abuse of their privileges by road users are too often applied to enforce an obsolete principle that any new type of vehicle necessarily constitutes "extraordinary traffic," and as such should be specially liable to contribute inordinate sums to the maintenance of the roads which it uses.

Lastly, we have the class of legislation which makes it expensive to be the possessor and user of a motor vehicle. Taxation of the motor owner on a strictly moderate scale may be justifiable, but directly such taxation becomes really high, it discourages the development of the industry and, furthermore, directs it into wrong channels. Thus, for example, the scheme of taxing motor vehicles on the basis of the horse-power of their engines necessarily depends on some arbitrary formula for the assessment of the power. The adoption of such a formula, in turn, encourages undue stress to be laid by manufacturers on so arranging matters as to bring their vehicles within a category, the taxation of which is low. This almost inevitably entails a bad influence on designers, who are encouraged to work with a view to getting round the formula rather than with the object of developing the most perfect engine possible.

These references to the effect of legislation have been rendered necessary because of the influence which such legislation has on the distribution of manufacturing centres of the motor industry of the world. It is a great advantage to any nation in the struggle for predominance in respect of any industry to be given a favourable handicap from the start. As regards legislation, the handicap has been unfavourable to the British

Empire, both in view of the points already mentioned, and because of a continued adhesion to principles of free trade during the vital period of early development; while other countries—and particularly the United States—were stimulating their own national motor industries by the imposition of tariffs which made the home market practically a closed preserve to the home manufacturer. It is to its scheme of tariffs that the United States is chiefly indebted for having attained to the distinction of being the country in which by far the largest number of motor vehicles are manufactured. There have, of course, been other factors at work, but the protective policy has been the most important of all.

Valuable statistics are fortunately available to indicate the rate at which the products of the motor industry have in certain important centres of population taken the place of the earlier forms of vehicular traffic. As the largest centre of all, a study of the traffic of London is particularly illuminating; but in quoting certain figures in this connection it must be borne in mind that the motor vehicle tends to predominate most rapidly in the greatest centres of population. Consequently, any attempt to assess the stage to which the change from horse to motor has progressed throughout the world must make allowances for the fact that in sparsely populated countries the transition almost inevitably takes place less quickly.

The Annual Traffic Censuses of the London Traffic Branch of the Board of Trade unfortunately only cover a very limited period, but this period is an exceedingly interesting one. Observations taken in 1913 showed that at that time 6 per cent. of the passenger vehicles of London were horse-drawn as against 13 per cent. in 1911. On the other hand, in 1911 no less than 94 per cent. of trade vehicles were horse-drawn, and by 1913

this figure had only decreased to 88 per cent. This indicates clearly enough that even at the beginning of this period, the change from horse to motor was almost complete in respect of passenger traffic; while, even at the end of the period, the change had only begun to progress in respect of trade vehicles.

Annual censuses in certain typical London thoroughfares have been taken over a considerable period of years on behalf of the paper *Motor Traction.* As indicative of the central traffic of London, a few figures referring to Fleet Street can be given. During a day in 1907, the number of omnibuses using that road totalled 3,236, of which 995 were motor-propelled. This corresponds to about 30 per cent. By the spring of 1912, the horsed omnibus had disappeared altogether, but the extra carrying capacity and speed of the motor bus enabled the increased bulk of traffic to be dealt with by a smaller number of vehicles. The total then recorded during the day was 2,770, which is interesting as showing how the adoption of the motor tends to reduce road congestion.

In the matter of cabs, in 1908 only 48 motor cabs passed as against 1,902 horsed cabs. The change had, in fact, only just begun. In 1914 it was practically complete, the motors predominating by 1,652 as against 74. Taking all passenger vehicles together, about 20 per cent. were motor-propelled in 1907; but by 1914 the horsed vehicle had almost disappeared, since it represented only 4 per cent. of the total.

As regards trade vehicles, a fairer estimate may be got by noting a few figures applying to the Edgware Road, which is a typical artery leading to the country. Here, in 1906, less than 1 per cent. of the trade traffic was represented by motor vehicles, while in 1913 the motor accounted for rather more than 10 per cent.

These few figures indicate that by the time the Great War broke out, that section of the motor industry which is concerned with the manufacture of private and passenger vehicles had, in the London area at least, almost reached the stage at which further development was dependent on increased population, or increased purchasing power of the individual. On the other hand, the industrial motor industry, as represented by the van and lorry, still admitted of expansion to something like ten times its dimensions in 1914, irrespective of any increase in the total bulk of goods to be carried.

The Great War must necessarily have affected the value of any figures resulting from observations taken since the summer of 1914, and even after the conclusion of war some little time must elapse before any fresh statistics can be regarded as normal. Consequently, it would probably only be misleading to go further at present into the question of how far the motor industry has yet filled its potential markets. With the interesting question of why the change in respect of passenger vehicles has so far preceded that in respect of trade vehicles, we shall deal in subsequent chapters.

CHAPTER II

FACTORS THAT HAVE ASSISTED DEVELOPMENT

THE motor industry owes its existence primarily to the tremendous progress made in the design and manufacture of internal combustion engines. According to Mr. Dugald Clerk, the total power generated by gas engines in the United Kingdom in 1876 did not exceed 2,000 horse-power. In 1907, a total of three-quarters of a million horse-power was employed in the engines of motor cars and cycles alone. In Germany, the total power of motor cars and cycles in the same year was about 180,000 horse. In 1909, nearly one and a quarter million horse-power went to propel the motor vehicles in use in the United States.

The internal-combustion engine manufacturing industry thus antedated the motor industry by about twenty years. Its enormous growth was due very largely to the introduction of the principle of action known as the Otto cycle. Though this principle was first successfully applied by Otto in 1876, it had been demonstrated theoretically by the French scientist, Beau de Rochas in 1862. The great bulk of motor car and cycle engines of the present day operate on the Otto cycle. This implies that the various necessary operations are performed during the course of four strokes of the piston, or two revolutions of the crankshaft. The underlying principle of highest importance is that which insists on the compression of the explosive mixture prior to its ignition in the cylinder.

As the design of the internal combustion engine improved, it became possible by its use to make high

power available, occupying only a small space and of no great weight. The fuel being burned in the engine itself, no boiler is necessary. Moreover, the fuel is obtainable in a convenient and handy form, and the utility of the engine is not dependent on the frequent renewal of considerable supplies of water.

The industry owes its progress also to the fortunate prior existence on the markets of a very suitable fuel, known in England as petrol and in America as gasoline. As a result of the treatment of crude oils obtained from the wells, a large number of products are secured, ranging from solids, such as paraffin wax, through liquids down to gases. Motor spirit is a combination of very light liquid hydrocarbons, which give off vapour easily at low temperatures. When this vapour is mingled with a suitable quantity of air, an explosive mixture is formed. If a fuel possessing this quality had not been readily available, the development of the motor vehicle would have been much slower. It would have waited on the production of a suitable fuel, and people would not have troubled to produce the suitable fuel until the engines were there to use it. In the early days of the industry, motor spirit was ready to hand, because it cannot help being produced in some quantities by those who set about the production of oils for lamps, fuel, and lubricating purposes. It was cheap because there was not much demand for it, except for cleaning purposes. It was almost ideal, because when it was used the engine could be started up easily by hand without the fuel being previously warmed so as to make it give off the necessary vapour. Moreover, it is clean and unobjectionable. As illustrative of the immense influence which the chance presence of petrol has had on the industry under consideration, we may mention, in passing, the efforts that

have been made more recently to increase the fuel supply by encouraging the cheap production of industrial alcohol. The very limited success that has attended these efforts is entirely due to the conditions which would have applied to the whole industry if petrol had not been an inevitable by-product resulting from the manufacture of oils for which there was a big demand. In the case of alcohol, most of those who could produce it in quantity consider that it is not worth their while to do so until engines have been designed really suitable to use it. On the other hand, engineers will not go to the trouble and expense of perfecting a high-speed alcohol motor while the supply of alcohol fuel is much restricted and very expensive. The position may be described as a vicious circle. Each party waits upon the other, and neither has sufficient incentive to move first. From this analogy we see how much the motor industry is indebted to the fortunate chance which provided the fuel even before any big demand existed for it.

Next among the factors that have assisted development should be mentioned the rubber tyre, and particularly the pneumatic tyre. The motor industry does not in any sense owe its inception to the pneumatic tyre, but it undoubtedly owes much of its rapid growth. The pneumatic tyre antedated the motor industry by some years, but at the time the motor industry began to develop, the pneumatic tyre was not generally considered to have reached such a stage of development as to be suitable to carry heavy loads. Its successful application was almost entirely limited to the bicycle and tricycle. The earliest motor cars were, as a rule, fitted with solid rubber tyres, which exercised considerable influence in popularising the motor vehicle by making fair speeds possible without excessive discomfort

under ordinary road conditions. It was not long, however, before tyre manufacturers, appreciating the immense possibilities of the pneumatic tyre in this connection, pushed ahead and filled all reasonable requirements. Without the pneumatic, what are now regarded as high or even moderate speeds would have been impossible, though solid-tyred vehicles may run up to about twenty-five miles per hour. The pneumatic tyre also assisted indirectly, inasmuch as by decreasing the tractive effort necessary for the propulsion of a given load, it much improved the performance and increased the popularity of the motor car. To-day, the motor car industry and the rubber tyre industry are inseparably linked together, and are interdependent. Despite this natural alliance, they are in another sense separate, considering that the individual interests of their members are not always identical. Thus, for example, the car manufacturer, in a desire to keep down price, may wish to fit comparatively small and cheap tyres. The tyre manufacturer, on the other hand, realises that the best results are obtained by generous tyre dimensions. Owing to this and other essential differences in internal policy, we do not propose to regard the tyre industry as coming within the scope of this book, but will content ourselves by making due acknowledgment of its influence and assistance.

There remains among the chief factors that have helped the motor industry to its present position the very valuable developments that have taken place as a result of the scientific study of metals, and particularly of steels. The motor industry and the iron and steel industry have perpetually interacted upon one another. The motor manufacturer, desirous of lightening and simplifying his structure without decreasing its strength, has created demands with which steel

manufacturers, contrary to previous experience, found themselves able to comply. The study of steel alloys, and the production of metals combining lightness with enormous strength, have been largely due to the pressure brought to bear by the motor industry. The success of that industry, in turn, has been largely due to the intelligent response of the steel manufacturer. In some measure, the motor industry may also fairly be said to be indebted to those who have studied aluminium and its uses, and made this particularly light material available to the motor engineer as a means of substantially decreasing weight without sacrificing essential strength.

CHAPTER III

INFLUENCES AFFECTING THE DISTRIBUTION OF THE WORLD'S MOTOR INDUSTRY

In considering the influences that have affected the growth and distribution of the industry very considerably, if not always quite directly, we must recognise, first, the effect of legislation, to which reference has already been made. So far, we have regarded this solely as an adverse influence, but it is clear that there are circumstances under which legislation can have the opposite effect. Take, for example, the scheme under which the German Government has for many years past supported trade banks, which in turn have supported industrial concerns, enabling them to develop new markets and to incur certain reasonable financial liabilities. Here, we obviously have an influence tending to make Germany an important manufacturing centre of the motor as of other industries. Then again, in France it has been the practice to stipulate that all vehicles built for Government or any sort of municipal service shall be wholly constructed in French factories by French labour. Import duties levied on all foreign cars evidently tend to establish the home motor industry of the country which imposes them. Subvention schemes, such as those put into force in and around the year 1910 by France, Germany, and Austria, and subsequently copied on a less generous scale by Great Britain, and primarily of military significance, but have the effect of encouraging the users of the heavier classes of commercial vehicle to buy from the manufacturers in their own country.

In considering the other causes that have led to the present distribution of the world's motor industry, our next reference should be to the road system. Here, we find Great Britain at an advantage, inasmuch as it possesses the finest and most complete road system of any country in the world. The gradients experienced on British roads call for ample power in the vehicles constructed to run upon them, but the all-round excellence of road surfaces greatly simplifies the work of producing motor cars that will under normal conditions prove reliable and popular. The pleasure of motoring is, naturally, in no small measure dependent on the condition of the roads; and where roads do not exist at all, the motor vehicle in its ordinary forms is practically useless. The frequent use of *pavé* makes the roads of most European countries inferior to those of Great Britain. In Russia, and in the Balkans, the whole road system needs development as regards not only the quality but the quantity of thoroughfares. In many parts of the United States, the use of motors is curtailed except in the vicinity of the larger centres of population. In the British Empire Overseas, the finest roads are to be found in India, but the number of really excellent roads even there is limited. Generalising with regard to the self-governing Dominions and Colonies, only an early stage of road development has been reached. Roughly speaking, the distribution of the motor manufacturing industry may be gauged by the condition and distribution of the roads of each country. The great exception is the United States, which, with an incomplete road system, supports an enormous motor industry, which fact brings us to another point.

This is, that the distribution of the industry must be dependent also on the purchasing capacity of the

The Vauxhall

The Sunbeam

TWO CARS, THE EXCELLENCE OF WHICH IS LARGELY DUE TO EXPERIENCE ON THE RACING TRACK

average member of the population in each country. In this respect, the United States has an immense advantage. The purchasing capacity of the individual is good and the population is large. There is thus created a home market of very large dimensions requiring to be filled partly by cars of high quality, but very largely by cheap cars. The classes in Great Britain or in France which correspond to those that are the principal purchasers of cheap cars in the States are not sufficiently well off to own cars at all. The numerical value of the home market in any European country is thus comparatively restricted. Meanwhile, the United States manufacturer, having the biggest home market at his disposal, and having that market safeguarded by a high tariff, was able to purchase and to build in large quantities. This big quantity production naturally led to a decrease in the works cost of each vehicle, and also in its selling cost. The lowering of the price of cars must, of course, react again, extending the market by bringing in fresh classes of the public as possible purchasers. This combination of influences has had such an effect that the number of cars owned per million of population is very much higher in the United States than in any other country, and this despite the comparative inadequacy of the road system. In one sense, even this inadequacy tends further to centralise the manufacturing industry in America. The builder of a car intended for use where roads are bad is, in fact, the builder of a car which is, or ought to be, suitable for use in almost every part of the world. On the other hand, the firm whose products are primarily designed for use on very smooth roads may be supposed to be inclined to ignore the modifications which would have to be introduced if his vehicles were to be employed where roads are bad. Thus, so far as the markets of

other countries are left open to him, the American manufacturer has perhaps the best chance of securing the bulk of those markets in countries that have no adequate manufacturing industry of their own. In this respect, he is certainly better circumstanced than the British manufacturer, but it must not be assumed from these remarks that the latter is incapable of building for the markets of the younger and less developed countries. This is not the case; but the point is that, when he does so, the British or the French manufacturer must produce special models. The American can sell his standard production, which, of course, involves him in far less trouble and expense.

Before leaving this branch of our subject, there is at least one more factor to be considered. This is the influence which the distribution of population has upon the distribution of the industry under consideration. This class of influence is most noticeable in respect of the industrial motor vehicle, which has been developed with particular strength in Great Britain, where all the conditions are favourable. First, we have, as already stated, a complete network of roads, which opens up possibilities of inter-urban and long distance traffic as well as town traffic. Next, we have the tendency noticeable in Great Britain for the population to move outward from the great business and shopping centres in their search for pleasant residential districts. If we compare London with Paris, we find that the population of the former is only half as dense as that of the latter. Roughly speaking, the population of London is double that of Paris, but the area covered by London is four times as great. This means that, on the average, the distance to be travelled in effecting delivery of goods from the shop to the customer is considerably greater in London than in Paris. Now, the industrial motor

vehicle has the best opportunity of showing its superiority over the horsed van when it is able to make full use of its greater speed capacity, and its power of covering a big daily mileage without tiring. Thence, it follows that, as a nursery for the industrial motor, London is far better than Paris. It is very difficult for the motor van to show economy in practice as against horsed vehicles, if it has to operate always within a short distance of its centre, covering a very small mileage and standing still during most of its time to effect deliveries. Under these conditions, it is standing idle during the greater part of the day, and only really moving freely for a small proportion of its working hours. The motor is, of course, more expensive than the horsed conveyance, so that, so long as they are both standing still, the horsed conveyance has the advantage as representing the smaller capital lying idle.

It would be difficult to exaggerate the influence that London has had, and is having, upon the general adoption of trade motors. The great central houses find it economically advantageous to serve their distant customers direct by motor van. The local traders in outlying districts are compelled by the stress of competition to follow suit. So the movement spreads like a snowball. On a lesser scale, the same thing goes on round every centre of population, until the whole country grows to realise the advantages of motor traction. Now, in a country where the great cities are isolated from one another so far as roads are concerned, this effect must be far less noticeable; and in other countries where the cities are very densely populated, and the residential suburbs very closely grouped around them, the gradual spread of the movement must necessarily be comparatively slow. By following up this

line of argument, we arrive at what has probably been the biggest factor in establishing Great Britain as an extremely important world-centre for the manufacture of industrial motor vehicles.

As a result of the influences mentioned and others of varying importance, the general distribution of the motor manufacturing industry is substantially as follows: Great Britain and the United States are the chief centres of the motor cycle industry. In the production of large quantities of cheap cars of good carrying capacity, the United States is unrivalled. Some European countries—notably Great Britain and France —have, however, established on a much smaller scale what may be called a competitive industry devoted to the manufacture of light cars of small horse-power and carrying capacity, but having certain points to recommend them as against the cheapest American vehicles. The manufacture of cars of moderate and high price is widespread, the principal centres being found in France, Great Britain, the United States, Italy, and Germany; while other countries participate in a lesser degree. It is difficult to assess the relative importance in this connection of the various countries named, and the order in which they are given must not be taken as very significant. The motor traction industry, concerned with the manufacture of public service and trade vehicles, is somewhat similarly distributed, though the influences referred to above have had their effect in locating its principal centres. The steam lorry and tractor are almost solely British products; while in the manufacture of electrically-propelled road vehicles, the United States predominates. The British Empire outside the Mother-country does not, as yet, occupy any prominent position as a nursery of this industry. On paper, the production of Canada appears to be

considerable, but, in fact, it consists much less of manufacturing than of assembling components manufactured in the United States.

Agricultural motors are manufactured in the largest quantities in the United States; but Great Britain, France, and Germany have their own industries producing machines specially suited to their own farming conditions. For the heavier types of marine motors, we are indebted mainly to the Scandinavian countries and to the factories on the Clyde. The lighter types principally come from America, which has a practical monopoly in the manufacture of the very small " outboard " marine motor sets applied to quite light rowing and sailing craft.

CHAPTER IV

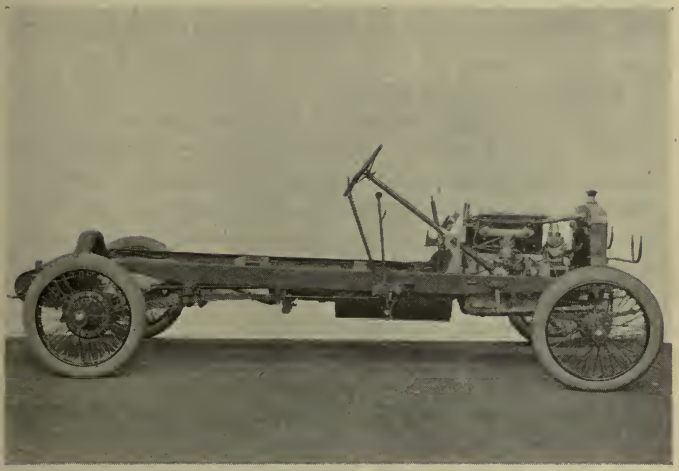
PROGRESS IN DESIGN

As applied to the earliest motor cars— if we ignore the unproductive experiments made with crude steam vehicles nearly a century ago—the internal combustion engine took its simplest form, having only one working cylinder. The charge was ignited by bringing it into contact with a heated tube. As time went on, the number of cylinders was increased, and electric ignition was introduced. The methods of preparing the fuel for admission to the engine were also vastly improved by the introduction of the spray carburetter. In the early days, the reluctance to increase the number of cylinders was due entirely to the fear of introducing more parts and complications in a machine which, even in its simplest form, gave frequent trouble. Unlike other engineering products, the motor car was destined to be handled and cared for mainly by amateurs. Thus, reliability was doubly essential. The increase in the number of cylinders from one to four consequently followed closely on the attainment of a high degree of reliability. It has already been remarked that the operations in each cylinder of an engine working on the Otto cycle occupy four strokes. With the single-cylinder engine, therefore, only one impulse was given during every two revolutions of the engine shaft. This meant a jerky form of propulsion, and evidently a very poor balance in the moving parts of the engine. Thus, constructors throughout the world were agreed in the adoption of four cylinders as soon as this became possible. To a prominent British firm belongs the credit of going

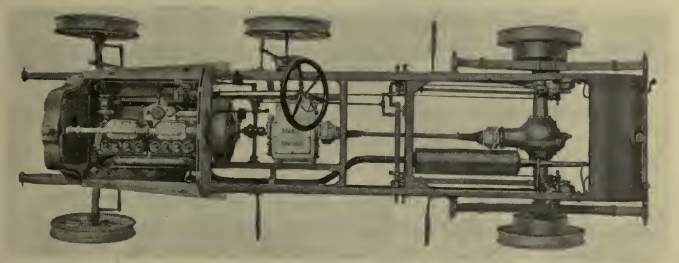
further and increasing the number of cylinders to six, in this way securing very perfect balance of the moving parts. When the six-cylinder engine was first introduced, motorists were still somewhat afraid of any unnecessary complications, feeling that they did not wish to face additional chances of breakdown. The American industry was slow to adopt the six-cylinder engine, but more recently it has gone forward yet further in this respect, producing cars the engines of which have eight and even twelve cylinders.

Meanwhile, in the matter of ignition, considerable credit must perforce be given to Germany, which became the centre of the magneto manufacturing industry, holding something approaching a monopoly in that direction until the outbreak of the war. The arrival of the magneto was a very important step in popularising motor vehicles, because it eliminated the small ignition batteries and trembler induction coils which were often sources of considerable worry, partly on account of intrinsic weaknesses, and partly because motorists generally, while getting a fair grip of mechanical principles, could not be persuaded to make a sufficient study of electrical theory and practice. Recently, there has been noticeable a tendency to revert to battery ignition in an improved form. This is due to the introduction of electric lighting and electric engine starters on modern cars. These new duties entail the presence of an electric generator and an electric motor. The former keeps the battery properly charged, so that its use for ignition as well as for lighting is not accompanied by the old drawbacks.

Another respect in which engine design has been modified to great advantage is with regard to lubrication. The old haphazard methods have been superseded by systems in which oil is taken in properly



Side Elevation of a 20 h.p. Daimler



Plan-view of a Clement-Talbot

regulated quantities to all the bearings. Improved lubrication has done much to make possible the high-speed motor of light weight and great power.

Increases in the number of cylinders above six entail the use of V-type engines. For the earlier developments of such designs, the motor cycle industry was mainly responsible. It is also upon the motor cycle that the two-stroke engine has up to the present been most used on land. This type is also very commonly employed in small marine sets, but so far it has not gained a sure footing as a standardised component of the motor car chassis.

In one particular feature of motor vehicle design, peculiarly little effective progress has been made since the early days. For the purpose of varying the road speeds corresponding to a given engine speed, sliding gears were from the first employed, but it was generally believed that they would rapidly be superseded by something more mechanically sound from the designer's standpoint. Epicyclic gears have certainly been used to some extent, while electric, hydraulic, and magnetic forms of transmission have also been tried. Despite every effort, however, the old sliding gear, in improved forms no doubt, still represents standard practice.

As regards transmission to the rear wheels, the roller chains originally fitted have been superseded on all but the heaviest vehicles. Where chains are used at all in the transmission, the silent varieties are generally preferred. Chain transmission has, however, largely given way to the system in which the drive is taken through a propeller shaft and gear to a live back axle. On this axle is situated the differential gear, which allows the engine to propel the rear wheels at different speeds while the vehicle is turning a corner. Previously, the differential was placed on a countershaft,

from sprockets on the end of which chains ran to chain wheels attached to the driving wheels of the vehicle, the back axle being a solid rod. In the drive to the rear axle, worm gear, originally pioneered by a British firm, is now frequently used, even on the heaviest industrial vehicles.

In the matter of springing, the principal change has been that which has led to the introduction of cantilever springs, though the old types of semi-elliptical spring is still to a great extent used. The interception of vibration from the road has also been assisted by the introduction of shock absorbers. In the early cars, the wheels were of wood, but metal wheels are now almost universal, and the wire wheel has gained ground. The great advantages which must attend any facilities for dealing with tyre repairs in the garage rather than on the road have led to the introduction of detachable wheels and detachable rims, which, taken together, may now be regarded as of general application.

In respect of tyres, the chief developments have been those aiming, first, at eliminating trouble due to punctures and bursts; and, secondly, at the prevention of skidding and side-slipping. In the latter connection, we have steel-studded tyres, and also rubber non-skids of various types. Ultimately, the latter is most likely to become general, though the metal-studded tyre has advantages on certain classes of road surface.

With the progress of design in the matter of bodywork, we shall deal later on. At the moment, all that is necessary is to mention that the original influence of the horsed carriage has been gradually superseded by rational design based upon the conditions of use of the motor car, irrespective of those of its predecessor. The changes have been in the direction of simplicity of line and contour, and improved protection from wind and rain.

In motor bicycles, development has by degrees led to the use of increased power and the common employment of two cylinders instead of one. Following upon the use of higher powers, the transmission system has been modified, the old twisted belt proving inadequate. The modern belt of V-section is frequently used in conjunction with a chain drive and a two or three-speed gear. Many passenger-carrying devices have been tried in connection with motor cycles. The first was the trailer, which was superseded by the fore-car. This, in turn, gave place to the side-car, which is the most sociable arrangement possible, and has proved far more satisfactory in practice than in theory. The line of demarcation between the motor car and the motor cycle industries has been approached from both sides, and is no longer clearly defined. From the motor car there has been developed the light car of low power, while from the motor cycle has come the cycle-car. It is impossible to say exactly where the cycle-car ends and the light car begins.

In marine motors, attention has been devoted mainly to safety against fire risks, and to the use of heavier and cheaper fuels than petrol.

Any detailed consideration of the design of engines and motor vehicles would be beyond the scope of this book. The foregoing brief sketch is intended merely to be indicative of the fact that the industry has not yet reached a state of finality. For some time to come, the general character of its products must vary from year to year. However, changes are now, as a rule, in matters of detail rather than in matters of general principle. Nevertheless, we have to reckon with the fact that the motor is manufactured for the general public and not by one engineer for the use of another, as is the case with most machinery. The public in

this, as in other respects, is always liable to be persuaded by the dictates of fashion, and consequently it is very difficult, if not impossible, for motor car manufacturers ever to reach a point at which they can confidently say that there is no likelihood of the design of their products being modified for several years to come. This tendency towards change in design to meet the fancies of the buyer must necessarily be a source of trouble to those who aim at complete standardisation, with a view to marketing their products at the lowest possible price.

CHAPTER V

THE PRIVATE CAR

We now proceed to a general consideration of the products of the motor industry, and the practical achievements of those products. First of all, the industry developed the motor car for touring purposes and to minister to the recreation of the individual. Later on, the private car became known as the "pleasure car," to distinguish it from the industrial or commercial vehicle. The name is, however, a bad one, for, as the industry grew, a bigger and bigger proportion of private cars began to be used not for pleasure purposes but essentially as utility vehicles, and nowadays many private cars may undoubtedly be classed as essentials in connection with the businesses of their owners.

Privately-owned motor vehicles group themselves naturally into various sections. First of all, we have what may be called the car *de luxe*. This is a very interesting type, since its existence was only made possible by the almost unique circumstances surrounding the motor industry. In the engineering industry generally, any attempt to approach absolute perfection, regardless of cost, is discouraged by the fact that a very slight improvement in quality or finish only justifies a very slight increase in the price paid. In the private motor car industry, however, circumstances are exceptional, because the individual member of the public, and not the public collectively, is the purchaser. Among the individual members of the public, there will always be some who are prepared to

pay a very big price for the very best thing of its kind obtainable. It does not matter to them whether the degree of superiority is small compared with the additional price paid. They want, and they will have, the best.

In a sense, we may find a parallel instance in artistic circles. Take, for example, portrait painters. There may be a very large number of good men who have a difficulty in obtaining commissions even at modest prices. There are always just a few who stand out from the crowd, either because of a superiority, perhaps very trifling, or because in some indefinable way they are capable of gratifying the public taste. These lucky few will get prices for their work beyond measure high in proportion to its intrinsic superiority over the work of other men. Except in respect of weapons of war, nations are not in the least disposed to pay fancy prices, merely with a view to getting something just a very little better than what others have got. The same applies to municipalities and big corporations and, broadly, to all the principal purchasers of engineering goods of almost every class. It is only the individual who can be successfully exploited in this way. When we say " exploited," the word is not used in any objectionable sense. The manufacturer of the car *de luxe* may very likely make no bigger percentage profit than the maker of a much cheaper vehicle. His appeal to his public is, however, based on quite different grounds, and he may be said to exploit the public only inasmuch as he asks twice the price for a vehicle which nobody could really say was twice as good as the best examples of moderate-priced cars. In attaining his comparatively slight superiority he may be involved in very high expenditure, and in lengthy and costly experiments. If he succeeds, his reward is considerable. If

he only manages to be regarded as the second or third best, his speculation may be considered as unsuccessful. In a sense, then, the manufacturers of the car *de luxe* may be looked upon as a little group fighting among themselves for one or two big prizes, the rest being likely to draw blanks, although, from the point of view of value for money, they may not be a whit inferior.

There is a wide gulf fixed between this group and the next and larger class, which comprises a very considerable number of manufacturers all aiming at a common object, namely, the production of a really good car, only intentionally stopping short of perfection when further improvements would result in advantage trifling in comparison to the cost. The market for this class of car is not dependent on the plutocrat. The moderate-priced car appeals to the man who is at least fairly well off, and to many who are very rich, but who have no special aspirations to excel in the value of their possessions. From a commercial standpoint, the business of this second group is therefore on a sounder basis. It is less liable to violent fluctuations owing to changes in fashion or fancy. It affords a more certain reward for anyone who gives really good value for money, success being more generally obtainable provided that it is deserved. In the production both of high and of good moderate-priced cars, Great Britain, France and Italy figure prominently, while the names of Germany and Austria cannot in honesty be excluded from the list of European countries. In America also, both the car *de luxe* and the admirably equipped car of moderate but not low price have been successfully produced, so successfully in some cases as to penetrate the markets in other countries.

In a general review of the American industry, however. these developments are apt to be overshadowed

by reason of the huge production of vehicles of much cheaper class, inferior as regards finish and attention to detail, though not necessarily as regards quality of material and the design and construction of the principal essential parts.

In respect of the cheap car of good carrying capacity and fairly high power, it is hardly likely that the supremacy of the American industry will be seriously challenged. The outputs of the biggest American concerns make those of the largest European manufacturers appear very nearly negligible. America has a huge home market for comparatively cheap cars, and the methods of her engineering industry are all in favour of standardisation and quantity production. The nearest European equivalent to the American cheap car is to be found in what is known as the light car. This is a vehicle with small seating capacity and small engine power. Its whole structure is light, and its appeal to the public is based less upon low first cost than upon low cost of maintenance. The argument is that the cost of motoring cannot be gauged simply by the cost of the car in the first instance. This is only one factor, others being the cost of maintenance while the car is in service, and the expenditure necessary to be incurred on tyre renewals and on fuel. The engine of the European light car is designed to run at a high rate of revolution, and to produce a power not actually large, but large in proportion to the tiny cylinder dimensions of the engine. This type of engine, if well designed and built, ought to be extremely economical in fuel. The American cheap car, on the other hand, generally favours a somewhat slower-running engine, not so economical in fuel and of larger dimensions in proportion to the power developed The light car carries two or at most three persons. Both the chassis

and the body are light, and consequently the load on the tyres is not considerable. The American light car is designed to carry four or five people. The more capacious body and the greater weight of passengers when the car is fully loaded contribute to increase the load upon the tyres. In the production of the European light car, considerable expenditure is involved in the effort to decrease weight. Thus, in respect of first cost, having regard to carrying capacity and engine power, it cannot compete with the American on anything approaching equal terms. It can compete successfully in practice only if it succeeds in justifying the claim that it is more economical in fuel and tyres, and involves a substantially lower annual bill for repairs and maintenance. The European light car must be, and will be, produced in much larger quantities than has been the case hitherto, but it will never be produced in the same quantities as the American cheap car.

CHAPTER VI

THE MOTOR CYCLE INDUSTRY

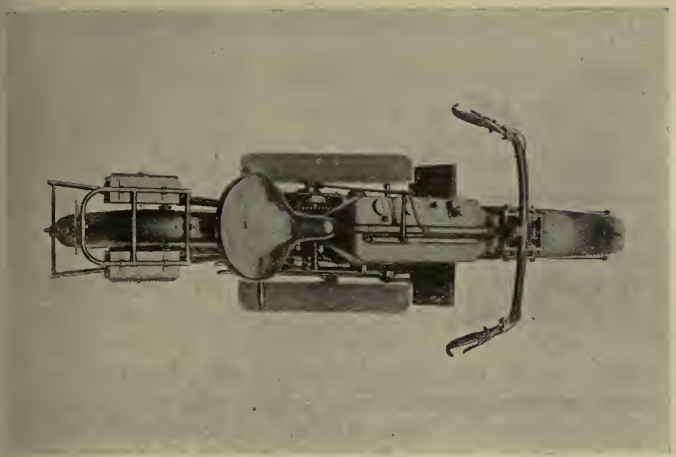
The distribution of the motor cycle industry is on the whole similar to that of the car industry. The main differences are that, in respect of the motor cycle, Great Britain has from the first occupied an extremely prominent position, while the effects of quantity production of American manufacturers have not up to the present been so noticeable in the markets of other countries. While capable of being used under very bad road conditions, the motor cycle is essentially a very light and speedy machine, and, as such, particularly liable to suffer rapid deterioration if consistently ill-used. Consequently, its popularity and success depends to a very high degree on the adequacy of the road system and the quality of the road surface. The advantages of Great Britain in this respect have necessarily had a strong influence on the location of the industry.

In a sense, this industry may perhaps be said to have developed from the early motor tricycles built in France. In its first successful form, the motor bicycle carried an engine of about $2\frac{1}{2}$ horse-power with one cylinder, air-cooled, and driving the rear wheel through the medium of a twisted leather belt direct from the engine pulley to the belt rim on the driving wheel. The engine could not be kept running unless the bicycle itself was in motion, as there was nothing in the nature of a clutch or change speed gear. The power of the engine was helped by the usual pedal gear and chain to the rear wheels, and the motor cyclist was compelled

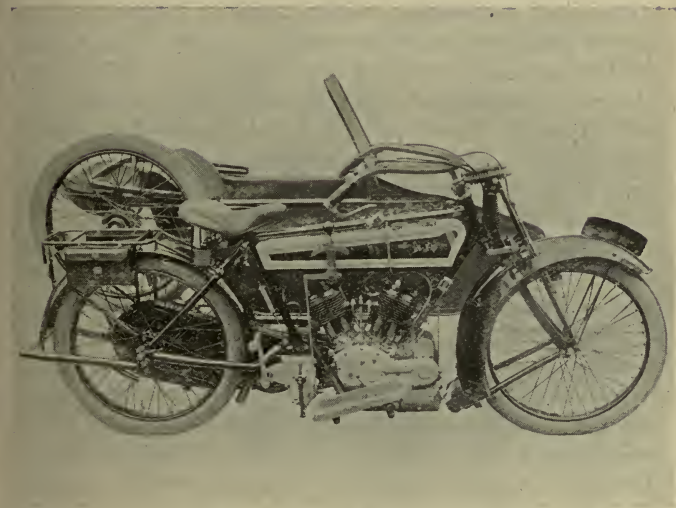
to make good use of his own legs on any stiff gradient. The machine could only be started by running it along the road at a rate corresponding to a sufficient engine speed. Meanwhile, matters were helped by a simple device, which prevented the exhaust valve of the engine from closing and so reduced the resistance to motion. With enough speed attained, the exhaust valve lifter was released, the engine then began to fire, and the rider jumped into the saddle. At this stage, the motor bicycle could evidently appeal only to fairly athletic people, and there was not much encouragement to increase the load and the difficulty of starting by adding any attachments for the carriage of additional passengers.

The first step in development was an increase in engine power. This led to the fairly frequent use of lightly-built trailers for passengers. These, however, were not particularly satisfactory. The passenger was too remote from the driver to permit of conversation, and badly placed as regards dust raised by the motor cycle and smell of the exhaust. Also there was always some danger of the trailer tipping over if a sharp bend was negotiated at any speed.

The next attempt to provide for a passenger was found in the introduction of the fore-car. This was a device which really turned the bicycle into a tricycle, having two steering wheels and one driving wheel, and thus differing from the majority of pedal tricycles. The fore-car idea gradually developed up to a point at which it ceased to be a mere attachment and led to the manufacture of three-wheeled machines known as tri-cars. In its highest form, the tri-car approximated closely to a light motor car, the essential difference being that it depended upon one driving wheel instead of two, no differential gear being required. The passenger was carried in front in a comfortable, sprung



An Enfield



An A.J.S. with Side-car Attached

A MODERN MOTOR BICYCLE IN PLAN AND IN ELEVATION

seat, sometimes made of basket-work and sometimes coach-built. The steering gear of the lighter-powered machines was of the ordinary handle-bar variety, but as engine power increased irreversible wheel steering was introduced. In certain designs, the engine power went up to 10 or 12 horse-power, the engine usually having two cylinders set at an angle to one another. The engine drove through a clutch and a two or three-speed gear, and thence by chain to the back wheel. The speeds attained were very high compared with those possible to a car of similar power, but the whole structure was generally on the light side and appealed to the sporting instincts rather than to those in search of a steady and reliable method of travel. Finally, water cooling was introduced and also magneto ignition. There still remained inherent defects, accentuated as power and speed were increased. For example, it was almost impossible to hold the machine on the road if the rear tyre became deflated, and repairs of that tyre were very difficult to effect. At that point, however, the tri-car had reached its furthest limit, and its price had so far increased as to approximate to that of a small car. Consequently, it may be said that designers had lost sight of the original object, which was to provide a very cheap motor for the carriage of a driver and a passenger. The tri-car really killed itself by super-refinement, though it still exists in a few examples, generally with side-by-side seats.

Meanwhile, the side-car had been introduced, and, though eminently unmechanical in principle, had proved satisfactory in practice. Its great advantage lay in the fact that the passenger was alongside the driver, and consequently conversation was comparatively easy. Some side-cars were designed so that their connection with the bicycle was flexible, while others were rigidly

attached. In the latter form, the side-car remains to-day the standard method of employing a motor bicycle for the conveyance of a passenger in some degree of comfort. In passing, mention ought perhaps to be made of the rather common practice of carrying a passenger on the luggage carrier behind the bicycle saddle. This is dangerous, especially when the roads are slippery, and it has led to many accidents. It is therefore to be hoped that it is only a temporary phase.

The introduction and common use of the side-car encouraged the tendency to increase the power of motor bicycles, and to add refinements in the way of clutches and change speed gears. Also, the old twisted belt was no longer adequate to transmit the increased power. Substantial V-shaped leather, rubber or composition belts came into use. More positive forms of drive are increasingly employed if the machine is liable to be used for side-car work, but the belt, on account of its flexibility tending to smoothness of motion, is still responsible for at least some part of the transmission in many cases where the motor cycle is used as a sole mount.

The general increase in horse-power due to the common requirement of motor cyclists, most of whom wished to take passengers on occasion, began to make the pastime more expensive and to limit it to the very young and athletic members of the community. As a result, a new type of machine sprang into existence. This is the modern light-weight motor bicycle of small power. It differs very materially from the early models, being fitted almost always with a clutch, and change speed gear. Thus, the engine can be started while the machine is at rest, and the power gradually applied through the medium of the clutch. The light-weight motor bicycle is therefore very handy in traffic, and commends itself

to the less youthful and more sober type of rider. A variety of gear ratios enables it to negotiate almost any hill, though its speed is necessarily small on heavy gradients. The engine is often of the "two-stroke" variety.

In the attempt to make provision for those sections of the public which remained just unable to afford a fully-equipped motor bicycle, or had no inclination for high speeds, various special power units have been designed as attachments to ordinary bicycles. In some cases, the power unit drives a small third wheel. In others, it is clipped on to the bicycle itself, driving the rear wheel through a light belt. Any device of this kind is necessarily in the nature of a compromise, and it is therefore to be doubted whether it represents any permanent development.

It has been mentioned that the tri-car, after a period of popularity, became practically extinct. This is true, if we regard it simply as a passenger-carrying vehicle. It led, however, to the design of three-wheeled trade carriers, which are now used in increasing numbers. These little machines are cheap to run and are handy in traffic, but probably have not the durability of a good four-wheeled light van. They are usually steered by tiller, and simplicity is the key-note of the whole of the mechanism. They carry loads up to 5 or 6 cwt. in substantial boxes mounted between the two front wheels. Motor bicycles with side-car combinations are also commonly fitted up as trade carriers to take 3 or 4 cwt. of goods. Even the motor bicycle alone can be applied in certain ways to trade purposes. Notably, it is employed for the rapid local distribution of evening papers.

This brief sketch of the motor cycle industry reveals a natural periodical tendency to develop up in the

direction of the motor car. The most recent evidence of this tendency has been the production of a number of light three- and four-wheeled machines known as "cycle-cars." In many of the designs somewhat unusual and untried features have been introduced, and, while a few notable successes have been obtained, it does not seem probable that the cycle-car has a very great future as distinct from the light car constructed on more ordinary car lines.

CHAPTER VII

PUBLIC SERVICE VEHICLES—THE MOTOR OMNIBUS

In the sphere of the public service vehicle, the products of the motor industry have made astonishingly rapid progress, resulting in the almost total displacement of passenger traffic dependent upon horse haulage. In face of the motor cab, the old horsed vehicle bids fair to end its already precarious existence very shortly. For pleasure trips, the motor char-à-banc has almost completely ousted the horsed variety, while, in more regular passenger service, the motor omnibus has practically completed its conquest of the field at its disposal. This last statement refers to those services hitherto operated by horsed omnibuses. The fight between the motor omnibus and the electric tram-car is more equal and more prolonged. The tram-car had the advantage of being there first, and of having been taken up by municipal authorities and exploited by them at the expense of the ratepayer and for the ratepayer's benefit.

Now, in most districts, the local authority has the power to grant or refuse licences to private individuals or companies asking permission to put vehicles on the road to ply for hire. Thus, when the motor bus came, its opportunity of demonstrating its advantages was often limited by the arbitrary treatment accorded to it. The local authority, having already involved the ratepayer in heavy capital expenditure on tramways, rather naturally refused itself to test any machine, the complete success of which must make the tram equipment

A Belsize Motor Omnibus Owned by the Leeds Corporation

One of the Typical Single-deckers of Paris

depreciate in value. It was equally unwilling to allow other people to demonstrate the capabilities of the motor omnibus in competition with the municipal tramways, thus reducing the profits of the latter. The consequence was that, in nearly every district, the development of the motor omnibus was deliberately restrained out of consideration for existing interests.

Fortunately, there were a few centres where this could not easily happen, and more fortunately still, these centres were of such importance as to provide public demonstration before the eyes of the whole world. In London, while the tram system was largely in the hands of the County Council, the horsed omnibuses which still ran into the central districts where trams could not penetrate were subject to licence, not by the Council but by the Commissioner of Police. It was his affair to consider the interests of the public desirous of travelling between their homes and the city, and not the interests of the Council regarded as a tramway proprietor. Consequently, motor buses were licensed under reasonable conditions, but not so freely as to allow unnecessarily noisy and unreliable vehicles to ply for hire. When the development had proceeded for a little time, the advisers of the police authority very rightly insisted that all motor omnibuses should comply with a set of more strict regulations as regards weight and design. By taking up this line, the police actually compelled the manufacturers to produce improved machines. The consequence of this was greatly to increase the popularity of the motor omnibus, so that what the industry first took to be a curse proved ultimately to be a blessing.

Meanwhile, the motor omnibus passed with some difficulty through a period during which it was made the subject of undue attention in financial circles. More

than once its reputation was jeopardised by faulty or unscrupulous finance, but finally the principal omnibus owners of London succeeded in consolidating their interests in such a way as almost entirely to exclude external competition, and to permit of operation on a scale rendering really economical maintenance possible. In this way, London came to possess the largest and, in many respects, the finest fleet of motor omnibuses in the world.

In the meantime, Paris also acted as a nursery for the new form of public service vehicle. In that city, the scheme of municipal ownership of such services does not find favour. The authorities prefer to grant monopolies to suitable companies in return for very complete undertakings as to the frequency and regularity of the service to be given. When the time came for the renewal of the monopoly granted in respect of Paris omnibus services, the opportunity was taken to displace all the horsed buses, and to enable the motor to pass from the period of experiment to the stage of full recognition. In the early days, the Paris motor omnibus superficially resembled the London type, being a double-decked vehicle. In this respect, it went even further, providing complete protection for the passengers on the upper deck. The result was perhaps some tendency towards top-heaviness. At any rate, one or two serious accidents occurred, and when the new monopoly was granted provision was made for the use only of single-decked machines. These have the interior divided to provide first and second-class accommodation, while a platform at the back is available for smokers. The total carrying capacity on the one deck is about the same as that provided on the two decks of a London omnibus. These latter take thirty-four passengers as against twenty-two carried on the old horse buses.

Later on, it turned out that the design of the Paris bus bodies had been subject to review by the military authorities, and it seems probable that insistence upon the single-decked type was really the result of possible military requirements rather than of any unsuitability inherent to the double-decked vehicle. At least, we know that, directly it became necessary to mobilise the French army, the whole of the Paris omnibuses were taken off the streets and their bodies converted in a few hours so as to render them suitable for the carriage of troops and supplies, a certain number being rapidly fitted up as emergency ambulances. Owing partly to the great length of body necessary to provide the required accommodation on one deck, the Paris omnibus is somewhat more cumbrous than the London variety. In both cases, however, the national industries have benefited by the passenger services of their capitals. The provision of upwards of 3,000 omnibuses for London and well over 1,000 for Paris gave valuable experience in the construction of heavy chassis, in the main suitable also for the carriage of goods. The performance of the vehicles in service was a fine demonstration of the great reliability of the industrial motor, and naturally had its influence upon the public.

As regards the future of the motor omnibus, developments from the present position must depend mainly on the result of the lengthy contest between bus and tram, or, in other words, between road traction and rail traction on public thoroughfares. Considering the two methods in the light of first principles, it stands to reason that railed traction has certain inherent advantages, inasmuch as the rails offer low resistance to motion, and can be so constructed and supported as to make possible the employment of heavier vehicles than could be used directly upon the road without damaging

effects. Then, again, the electric tram takes its power from a central station where large engines can be employed. It is always more economical to manufacture in large quantities than in small quantities, and consequently the fuel costs involved in generating power for trams should be, and are, lower than the costs involved in generating sufficient power to carry the same number of people in motor omnibuses, each of which carries, so to speak, a little power station of its own. Furthermore, the central station method admits of the use of the cheapest fuel, whereas the motor omnibus engine must depend upon a fuel that is conveniently portable and concentrated, even though more expensive in proportion to its calorific value.

On the other side of the balance sheet, we must take into account the inflexible character of the railed vehicle. The part of the road occupied by rails must be, to all intents and purposes, given up to railed traffic. Thus, the road is in effect narrowed, and rendered less capable of dealing with a congestion of traffic of all kinds. Then again, the tramway system cannot be immediately extended or reduced at will. When a new route has to be covered, considerable preliminary expenditure must be faced, and, if the service prove a financial failure, much of this expenditure is waste. In many places, a special demand for carrying facilities springs up only on special occasions. For example, many of the services wanted on a week-day are not required on a Sunday, while on Sunday special services are desirable to take town dwellers out into the country. With motor omnibuses, all such adaptations are perfectly easy. With trams, they are impossible.

The inflexible character of the tram system leads to another serious defect. During what is known as the " rush " hours, when a string of trams are passing

continuously near the centre of the system, all the cars are held up when passengers wish to board or leave the front car. Thus, when a large number of people want to leave the city for one place, the trams going to many other outlying districts are also hindered. When omnibuses are used, a rush to any one district affects only individual vehicles on that particular service, the point being that the buses can pass and re-pass one another.

So important are these results of flexibility that it is found that omnibuses can operate in central areas where trams are impossible, and also that, where trams and buses run along parallel routes, the buses are by far the more popular.

In view of all the circumstances, it would be unreasonable to expect the motor omnibus to lead to the rapid extinction of the electric tram. It would be equally unreasonable to conclude that the electric tramway system will continue to develop as it would have done if the motor omnibus had not arrived. There will be an increasing realisation of the fact that the two types of vehicle should operate in conjunction. The omnibuses are the better in central areas of congested traffic. The trams, if not better in all respects, are at least more economical for dealing with the carriage of very large numbers of people from points near the centre to points in the populous suburbs. Beyond a certain limit, at which only comparatively infrequent service is justified, the bus is again the best thing. If it be determined that mixed traffic is undesirable, then the final decision must be in favour of the omnibus, despite the somewhat higher cost of carrying each passenger over a given distance. The omnibus has, of course, the immense advantage of comparatively low first cost, and of not involving the erection of permanent

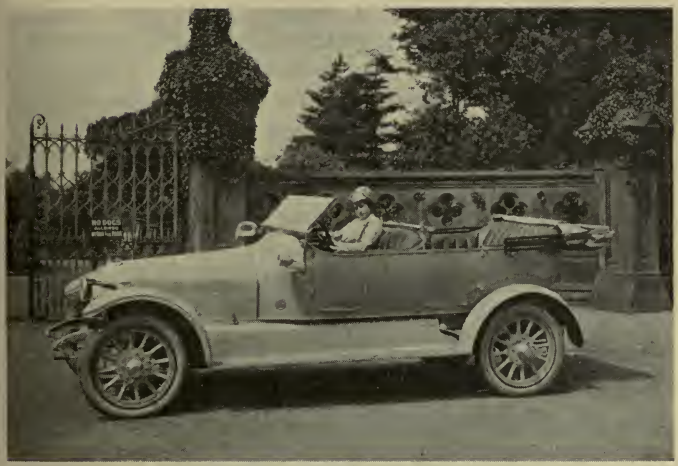
obstructions in the way of other traffic, or permanent disfigurements of town or country. It has another advantage, inasmuch as it can pick up and set down its passengers in safety near the kerb, which the tram cannot do. In future, comparatively small and growing communities will no doubt prefer to begin by utilising motor omnibuses, and will only even consider trams when the bulk of traffic has become considerable. Thus, all things considered, there is undoubtedly a very big future before the motor omnibus.

CHAPTER VIII

PUBLIC SERVICE VEHICLES—THE MOTOR CAB AND THE CHAR-À-BANC

THE history of the motor cab has been curious in more ways than one. Perhaps the most interesting fact is that the very rapid development of motors in this sphere was largely due to a quite extraneous circumstance. For years past, the public, while tolerating the cab driver as a proverbial humorist, had very much disliked his practice of trading upon their comparative ignorance to extort fares immensely in excess of the legal charges. Just at the time when the lighter class of motor vehicle had proved itself so reliable and durable as to make the motor cab a feasible proposition, there was also introduced that admirable instrument, the taximeter. This is, of course, a machine which registers alternatively by distance or by time. If the speed is above a certain set figure, then the distance travelled is registered, or rather the legitimate fare corresponding to that distance. If the speed is below the determined limit, then the fare is registered in accordance with the time during which the vehicle is occupied. Evidently, if a reliable taximeter is fitted, it is very difficult for the driver to defraud the passenger either by exaggerating the distance covered, or overcharging for the time spent in standing to await further instructions. The old cab driver in most places did not take kindly to this innovation. He was making a good living as the result of extortion rather than legitimate profit, and he did not realise that he was face to face with a crisis.

A Star Motor Coach



A Private Car of the same Make

THE MOTOR CHAR-À-BANC NOW APPROXIMATES IN APPEARANCE TO THE PRIVATE CAR. THIS FACT IS ILLUSTRATED BY THE ACCOMPANYING PHOTOGRAPHS

Consequently, he would have nothing to do with the taximeter. Meanwhile, the new motor cab companies in course of formation worked on different lines altogether, not hiring out their vehicles to the drivers for so much a day, but employing the drivers for a fixed wage together with a share in the takings. Under such circumstances, the taximeter became a necessity as a means of safeguarding the interests of the operating company as well as of the public. It thus became from the very early days a recognised accessory of the motor cab, as distinct from the horsed cab, to such an extent that, for example, in London, the motor cab is still popularly known as a "taxi." In Paris, this title alone would be unsatisfactory, for the reason that the driver of the old horsed *fiacre* was more sensible than the London cabman, and, bowing to the inevitable, adopted the taximeter, so that his vehicle is now a "taxi," the motor cab being a "taxi-auto." The result was that, while in London the horsed cab became obsolete in a very few years, in Paris the *fiacre* continued to be used by people who were in no particular hurry, its very slowness being one of its advantages, while another was the slightly lower scale of fares as against the motor.

Now, as to the difficulties of the motor cab industry. Even more than the motor omnibus it has been affected by faulty or irregular finance. It suffered also as a result of its prompt success. New companies sprang up one after the other with undue rapidity. Competition was very severe, and each new concern tried to get the pick of the business by offering a higher degree of luxury than its predecessors. Meanwhile, the fares chargeable continued to be regulated either by the police or by the local licensing authority. What was adequate enough for the profitable operation of a simple

two-cylindered vehicle of moderate power left, at best, a very small margin of profit when a more powerful four-cylinder engine was fitted and big expenditure incurred upon the body and its accessories and adornments. At the same time, the price of fuel rose materially, and, in consequence, drivers, who were generally expected to pay for their own fuel, became discontented and made protests which were in many cases successful. Thus, the motor cab industry in many places became rather unsound at base and frequently unprofitable. Drivers developed extraordinary ingenuity in the way of getting more than their proper share of the profits, and it is to be feared that the public often assisted them. In some towns, as, for example, London, a fair standard of excellence of the vehicles licensed for hire was maintained by careful supervision. In other districts, some extremely ramshackle machines were allowed to ply. At times, some very queer measures were resorted to in order to obtain custom. Thus, for instance, when in Paris one or two companies, owing to the superiority of their vehicles, began to get the cream of the business, many of the smaller concerns took their cabs in for a few days and re-painted them almost in exact imitation of their successful rivals.

In smaller centres, the hire car is often preferred to the cab, the difference being that, while the former is not licensed to "ply for hire," the fare chargeable for its use is a matter of arrangement, and consequently can be modified to meet varying costs of operation. Considered generally, while the employment of motor cabs must inevitably increase, this class of vehicle cannot be reckoned among those upon which the prospects of the motor industry are most firmly based.

On the other hand, the possibilities of the motor char-à-banc or touring coach are practically limitless.

This development started with the usual somewhat slavish imitation of the old horsed vehicle which it has now almost supplanted. On a substantial motor chassis was mounted a body consisting of a large number of rows of hard seats running up from front to rear. A wooden canopy was often provided to protect the passengers more or less from rain, but the sides of the seats were open, and altogether the arrangement was quite inadequate for the higher speeds of the motor vehicle.

It was not long before matters improved, first, by the addition of side doors and then by the provision of much wider and more comfortable seats. Finally, the motor char-à-banc became the motor coach, which in general appearance is like a magnified touring car. The body lines are simple, and there is no great rake from front to rear. High side doors are fitted, and very commonly some space is provided for luggage. As regards the chassis, this is closely akin to that of the 2 or 3-ton commercial motor vehicle. Frequently, however, the engine power is higher, and appropriate gear ratios are provided. Except for the use of solid as against pneumatic tyres, there is nothing in the modern motor coach to make it appreciably less comfortable than the private car. The vehicles are generally open, being provided merely with cape cart hoods and wind-screens. It has been found that this type is the most popular so long as the weather is good, and as the great majority of motor chars-à-bancs operate only during the finer seasons of the year, bad weather may be assumed to be the exception rather than the rule. In some districts, however, chars-à-bancs or coaches are used not only for pleasure trips, but for the conduct of more or less regular services throughout the year. Then, some compromise as regards body design,

involving better protection from wind and rain, becomes necessary.

First of all, the motor char-à-banc merely competed with the horsed variety, but as time went on it created a new class of traffic for itself. Nowadays, it frequently figures as one of the greatest attractions of the health resort whether at the seaside or inland. Char-à-banc proprietors find that there is an extraordinary demand for quite long and comparatively expensive trips, lasting the entire day or even longer. In some instances, trips have been made occupying a whole week, inclusive fares being charged for the drive and for hotel accommodation. It is probable that as yet we have touched only the fringe of this new development. Consequently, the motor char-à-banc has not reached its high-water mark when it has succeeded in supplanting altogether the horsed vehicle of the same kind. Its greatest possibilities lie in the creation of new business which the horsed vehicle could never have touched. The fares obtainable are as a rule good, and in very many instances the profits resulting from the operation of a motor coach during its first season upon the road have covered the whole cost of the vehicle. The motor coach proprietor is generally the owner of a well-equipped garage, and the two businesses work in well together, especially in fairly large centres where there are a good number of industrial motor vehicles to be maintained and periodically overhauled. In many such districts, there is good business to be done with substantial chassis to which can be applied alternative bodies for the carriage of goods or of passengers. Such machines operate as vans or lorries during the working week, and as chars-à-bancs on Sundays and holidays.

CHAPTER IX

THE INDUSTRIAL MOTOR

We come now to what is doubtless destined to be the most important of all the branches of the motor industry. In revolutionising the means of carrying passengers along roads, the motor has been immensely successful, and has affected the life of civilised countries in no slight degree, notably by encouraging people to live in country districts which, in the old days, were not sufficiently accessible for those who had any serious work to do. All that can be done in this direction, however, is nothing to the immense potential influence of the goods-carrying motor vehicle. In almost all parts of the world, there are still countries and huge districts awaiting development. Such development is impossible, unless the products of these young lands can be marketed at a reasonable cost and a reasonable speed. The problem of world development is in fact the problem of transport. Up to a point, shipping effects the desired end, but the result of sea transport alone is merely to develop patches of country lying within easy reach of ports. Much can be accomplished by means of railways, but these again have their limitations. The cost of providing a complete close network is immense, and without such a network of communications development still remains only partial, and is limited to long narrow strips.

Whatever else may be done, we always, in the end, come back to the road and the use of wheeled traffic

A big Commercial Car Lorry under trial by the Military Authorities in Russia

An Auto-carrier Owned by the British War Office

as the universal means of establishing land communications. Animal traffic fails when distances are considerable, but motor vehicles do not tire and motor roads can be constructed for a very small percentage of the cost of the railway. Thus, by first building roads, the early stages of development of a new country may be accelerated, the whole of the produce being carried by motor. Later on, a railway may be justified, and then the adaptability of the motor is recognised at its full value. The cars can at any moment be put on to new routes and used as feeders of the railway rather than as a complete transport system in themselves.

In more developed countries, the industrial motor must sooner or later displace horsed traffic entirely, because it has certain advantages which the older method could never possess. First of all comes its immensely increased radius of action. This enables goods to be delivered direct from the producer or manufacturer to the consumer at any distance. Particularly when the goods are of a perishable character, this is of the highest importance. The motor saves time and also saves handling. Compare the new with the old method. The produce—fruit perhaps, or vegetables—is packed and placed upon the motor, by which it is taken direct to the market, thence to be distributed. Under the old plan, the produce, when packed, had to be loaded on to a cart, unloaded at the railway station, and there subjected to delay. Next, it must be loaded again on to the train and, after more delay and a journey probably involving much shunting and jolting, unloaded at another station. Here must occur another delay, again to be followed by loading on to a second cart, yet another journey, and a third unloading at the market. Every handling must necessarily mean bruising

and damage. Every delay must mean loss of freshness, and often loss of market by late arrival.

Next consider the use of the motor van for effecting deliveries of retail goods. The buyer naturally wants his purchases to reach his house as promptly as possible. He lives, perhaps, ten or twenty miles away from the business centre where he does his shopping. The old-fashioned shop effects its deliveries by the employment of horsed vans, railway, and horsed vehicles again. The store which works on more modern lines employs motor vans either of its own or under contract with some big carrier. These take the goods direct from the packing department of the shop to the customer's door. This is so much more satisfactory that any business concern working along the old lines must soon fail to hold its custom unless it can give far better value for money. This it cannot do, for, granting certain exceptions, motor deliveries are, taken all round, more economical than delivery by horse and railway. Thus, when once a few progressive houses have adopted motors, their competitors are forced to do the same. In so doing, their radius of action is increased and they come into competition with the shops of other towns. These in turn are compelled to bestir themselves. Thus, when once the principle is grasped, development from beginning to end is bound to follow. At present, this development has sufficed to convert only a small percentage of trade vehicles into motors. There remains, therefore, an immense field at present untouched.

In almost every trade, there are special reasons why motors have to be used. Thus, in the work of furniture removal, journeys of forty or fifty miles can be undertaken by motor in, let us say, six hours or so. If horsed pantechnicons and the railway were used, two

or three days would very likely be occupied before the furniture taken from one house could begin to be placed into the other. As another example, take the brewer or mineral water manufacturer. His trade is unequal, and is dependent upon seasons and weather. Just when the latter is most trying for horses there is most work to be done. Motors can at such "rush" periods be kept going day and night to cope with sudden big demands.

Motors are not by any means always antagonistic to the railways. Often, they are supplementary to them. Where a branch line is not yet justifiable, a motor service can be run to encourage traffic of passengers, mails, and goods, and to develop it up to the point at which a railway may become profitable. Railways also can, and do, employ motors extensively for the collection and delivery of goods sent for long distances over their lines.

Much of the work of the carriage of goods by motor already is, and will continue to be, done by carriers and haulage contractors. Such firms, undertaking haulage and deliveries for a large number of concerns, can maintain substantial fleets of vehicles of all suitable load capacities. If a breakdown occurs, a spare car can be ready to take over the work. If there is a sudden rush of business, extra vehicles can be put on. There are, in fact, many advantages in dealing with the haulage contractor, and in many cases these are sufficiently important to justify paying the price which will allow the contractor himself to make his fair profit. In some districts, contractors do substantial business in the carriage of mails by motor van. Thus, for example, motor mail vans, running under contract for the Post Office, operate nightly from London to cities more than one hundred miles distant. In some sparsely

populated districts, a service of motors provides the only public means of transport for both passengers and mails, as well as for goods in small quantities.

These few exceptions will suffice to indicate the ubiquity of the industrial motor. In its various modifications, it is bound to pervade, and ultimately to be almost entirely responsible for, the whole world system of road transport.

Industrial motor vehicles are built suitable to carry any load from a few hundredweights up to 5 or 6 tons. The lightest machines run on pneumatic tyres, and are almost as speedy as the private cars. The heavier varieties are fitted with solid tyres, and are somewhat slower. Thus, a 10 cwt. light van may average eighteen to twenty miles an hour, and a 30 cwt. van twelve to thirteen, while a 4 or 5-tonner may average only eight or nine miles an hour. Despite the lower speeds, the heavier types of vehicles offer the most economical means of carrying goods by road, assuming that the available loads are big enough to keep the machines fully occupied.

Where industrial motors have failed to show economy, the fault has been more often than not due to the motor owner. Sometimes, the vehicles are not properly looked after and maintained. Sometimes, they are badly driven. Sometimes, no effort is made to re-organise the system of delivery, so as to adapt it to a new and quite different method. If the whole system is schemed out properly, a motor van will take the place of two, three, or even four horsed vehicles of similar carrying capacity. The only sort of work in which the ability of the motor to show economy over horsed traffic is questionable is in effecting a number of small deliveries over a very short round. Under such conditions, even a motor can cover only a few miles in the day, and when

this is the case, it does not get a fair chance of benefiting by its qualities of speed and tirelessness.

In a very few years' time, there will be ten motor lorries and vans on the road for every one that we see to-day. Here, then, is an enormous field for the development of the industry, and some slight indication of the immense effect that the industry as a whole is destined to have upon civilisation and the development of all the countries in the world.

CHAPTER X

MOTORS IN LOCAL GOVERNMENT SERVICE

The field for the employment of motor vehicles in local Government service is necessarily limited, but is nevertheless very varied. In the early days of the movement, the local authorities generally were not favourably disposed towards motor vehicles. They looked upon them primarily as road destroyers, and as dangerous contrivances from which the public needed to be protected. As time went on, there came a realisation of the fact that the revolution in traffic was so important as to necessitate basic changes in the methods of road construction. We cannot blame new wine for bursting old bottles, or new forms of traffic for injuring roads designed solely for the old. The people who established the principles of road construction as we have known it in the past, brought their intelligences to bear on problems as they were, not as they might be at some future date. They thus created a system of roads admirably suited to withstand the stress of horsed traffic. When motor traffic came, the requirements of road construction were varied, and changes had to be effected. Particularly, during the transition stage, the difficulties of the road surveyor are accentuated, since he is required to provide something suited both to the old and to the new systems. Road surfaces are, of course, disintegrated as the result of sharp blows from horses' hoofs and the passage of narrow steel tyres. The old traffic did not, however, raise much of the dust which was thus formed. Afterwards came the motor, and, without doing so much real damage, gave a much

greater appearance of damage by throwing dust on to the hedgerows, the fields, and the adjacent houses. A pneumatic-tyred vehicle travelling at speed sucks at the pores of the road with its tyres. Moreover, there must always be an abrasive action between the road and the tyres of the driving wheels. The heavier types of motor tend to exercise a crushing effect if road foundations are inadequate, and also to work up the road surface into a series of undulations or waves. We are only now beginning to understand road construction in the light of modern conditions.

Local authorities failed also to realise what motors are capable of doing for them in the way of preventing congestion of traffic. Without going into this subject in detail, let us take one example. A horsed omnibus carries, say, twenty people at the rate of six miles per hour. A motor omnibus carries over thirty people at, say, ten miles per hour. The motor is certainly of no greater length than the horsed vehicle and its horses. Consequently, it occupies only about the same amount of road. Its efficiency as a traffic unit can be gauged by its carrying capacity and the number of journeys which it can make in a given time. It makes approximately ten journeys to six of the horsed omnibus, and carries about thirty people. Thus, its value for purposes of comparison may be stated as the product of 10 into 30 ; that is to say, 300. The corresponding figure for the horsed vehicle is the product of 6 into 20 ; that is to say, 120. The motor bus thus deals with at least as much traffic as two-and-a-half-horsed omnibuses, and in so doing occupies only the same amount of space. Consequently, by using motors instead of horses, we can carry two-and-a-half times as many people along a given road without increasing the congestion of traffic. A similar argument could be applied

to all other forms of motor and horsed traffic, and, to take a conservative estimate, we see that by the introduction of motors we double the carrying capacity of our streets before the congestion becomes such as to render widening necessary. Therefore, even if the motor entails some extra expenditure upon road surface—which is not always the case—it saves a great deal of money which would otherwise have to be spent on expensive road widening in central areas. Incidentally, it also saves both congestion and expense by doing away with the need for scavengers, and on the same score is beneficial to the health of people, and particularly of children, living in cities and towns.

On the balance, then, local authorities certainly have good reason to encourage the use of motors and to set an example to that end. In performing the duties which fall to the lot of the local government bodies, motors are invaluable in many spheres.

First, we have to consider their advantages in the work of saving life and property. Here, we have the motor ambulance to deal promptly with street accidents and to carry infectious and critical cases to the hospitals. In such matters, the saving of a few minutes may make the difference between life and death. The same applies to the equipment provided for fighting fire. In all considerable centres, the horsed fire-engine has become obsolete. Motor fire-engines can get to work more quickly, and can pump larger volumes of water to a greater height. Motor escapes help to save lives in the event of fire, and to enable firemen to get to work, with the minimum of delay, in all parts of the interior of the buildings affected. Fire brigades also require lighter motor vehicles for the carriage of their officers to the scene of action.

In the more everyday work of a town, motors are

available for road watering and sweeping, and are far more efficient than horsed vehicles, because they can do their work more rapidly. For refuse collection, heavy motors can be employed with advantage, working by night and taking their loads to the destructors. In connection with tramway systems, motor tower waggons are valuable as a means of dealing promptly with troubles connected with the system of overhead wires. In road construction, motor lorries with side or end-tipping bodies can be advantageously used for the carriage of road metal. Special types of motor are constructed for the purpose of road rolling, or adapted to that use, although originally built primarily for other work. Nowadays, every up-to-date municipality owns a considerable number of the lighter classes of motor vehicle for the conveyance of its officials and of supplies of various sorts. We have dealt separately with the motor omnibus, but this is obviously a type of vehicle which lends itself to municipal ownership. There are also possibilities in the way of municipal services for the local carriage of parcels and light goods.

CHAPTER XI

MOTORS IN MILITARY SERVICE

Traction engines and tractors were used in small numbers during the South African war ; a fleet of light motor vans was of considerable service to the Italians during their campaign in Tripoli, and a fair number of motors, noteworthy for their variety rather than their high quality, did service in the wars limited to the Balkan States. Nevertheless, it was not until the Great War broke out that it was demonstrated once and for all that the motor is a necessary adjunct to the maintenance of modern armies in the field, and consequently that a strong national motor industry is absolutely essential to any country that would stand prepared to defend its position as a Power of consequence.

All the advantages possessed by motors as against horsed transport for military purposes are directly or indirectly connected with the qualities of comparatively high speed and great endurance. So long as the supplies of food and ammunition had to be brought up from the railways by horsed transport, the mobility of an army in the field was limited by the necessity of operating within a workable radius of railhead. Moreover, the extensive use of horsed vehicles led to a terrible amount of congestion along the lines of communication. In the event of a successful offensive justifying an advance, the possibility of making full use of an initial success was limited by the difficulty of bringing up further supplies of food and ammunition at a sufficient rate in support of the advancing troops. On the other hand, when for any reason a retreat became

necessary, the occupation of the principal lines of communication by cumbrous and slow-moving vehicles greatly increased the danger of such a manoeuvre, and not infrequently turned what would otherwise have been only a temporary set-back into a serious defeat. When horsed transport was used, the work of supplying troops at any distance from the railhead involved a very complex organisation. A convoy or *échelon* of vehicles took up the load at railhead and transported it over a mileage limited by the endurance of horseflesh. At some point, say, ten to twelve miles forward, the first *échelon* transferred its load to the second *échelon*, which carried it on for a similar distance. Thus, bit by bit, the supplies were brought forward to points near the front, from which they were distributed in detail to the troops. Clearly, under this system, several days might elapse between the time when food arrived at railhead and the time when it could be distributed among the men. When an army was advancing, it was difficult to arrange for the transport to bring supplies forward at an appreciably greater speed than that averaged by the troops themselves. The evacuation of the wounded presented similar problems, and slow transport led to much avoidable loss of life.

When motor transport is used, the journey from railhead to the distributing points adjacent to the front, or from the field hospital or the dressing station to the base hospital or the railway, is made in a single run. The speed of a motor convoy is such that, even if the troops are advancing throughout the day, the arrival of the supplies occurs very little later than if the army were stationary. Moreover, the extra carrying power and speed of mechanical transport makes it possible for one motor lorry to do as much work as four or five horsed vehicles of similar capacity. Thus, the

A Humber Car with Ambulance Trailer

A Napier Ambulance

congestion of the lines of communication is immensely reduced, and this again reacts on the speed which can be maintained. Similarly, during a retreat, motor vehicles have no difficulty in moving at such a rate as to impose no serious obstacles to the passage of the troops themselves.

It would be no exaggeration to say that the nature of modern warfare follows largely as a result of the use of motor vehicles. These make it possible to hold positions remote from railway communications in face of tremendous concentration of artillery fire, because motors can be used to replace the railways themselves, and to bring up ammunition in sufficient quantities to establish a balance. An extraordinary example of this character occurred during the earlier stages of the battle of Verdun. The French troops found themselves subjected to a terrible onslaught backed by an enormous concentration of artillery. They had to hold positions at a long distance from railway communications. The emergency was met by the establishment of an endless chain of motor lorries between railhead and the front. The vehicles forming the links of this chain moved at a slow but steady speed. Loading went on perpetually at railhead, and unloading perpetually at the forward end of the chain. The scheme worked like a bucket-dredger, in which buckets in a continuous string continually fill and empty themselves when in determined positions.

In many other spheres than that of transport and supply motors are almost, if not quite, equally essential under the conditions of modern war. High speed cars are a necessary adjunct at headquarters for the conveyance of staff officers. Motor bicycles afford an unequalled means of travel for despatch riders. Motor omnibuses, and motor vehicles generally, enable troops to be very rapidly brought forward and concentrated

at any threatened point, or at any point from which the enemy can be threatened. Thus, one of the important preliminaries to the Battle of the Marne was the rapid conveyance of a French army by motor car and motor cab around Paris. This movement, the first of its kind on a grand scale, enabled the flank of the advancing German armies to be turned, and was largely instrumental in the decisive results of the battle which saved France and the Allied cause.

It will be easily realised that the great military utility of motor vehicles, and the consequent continuous demand for the existence of large numbers of machines of types suitable for this class of work, have certain definite influences upon the motor manufacturing industry. First, there is the tendency to encourage standardisation. Military motors as a rule have to work in convoys, and it would be very difficult for a convoy to operate with its units at short intervals if the engine powers and gear ratios of the vehicles varied materially. We want, then, to arrive at some suitable standard as regards power and gears, or, in other words, the Government requiring military vehicles must endeavour to influence manufacturers towards standardisation. Again, it is obviously advisable that the control levers and pedals should be arranged according to some standard plan, so that a man who can drive one lorry can equally well drive another without experience. Most important of all is the question of maintaining military vehicles in the field. Dependence has to be placed largely upon travelling workshops—the equipment of which is necessarily limited—supported by lorries carrying stocks of spare parts. If all our vehicles are of one pattern, then the number of spare parts that has to be carried is reduced to a minimum, and so is the number of different machines required in

connection with ordinary repairs. Thus, in military work there is everything to be said for considerable standardisation and nothing to be said against it. That standardisation is possible as regards essentials, without strangling the individuality of manufacturers, has been proved in practice, particularly by the way in which the British Government scheme has panned out.

In its early stages, it seemed probable that this scheme would tend to discourage the construction of chain-driven motor lorries, but in this particular respect the original provisions of the Government specification could not be strictly adhered to when the Great War necessitated the production of very large quantities of military vehicles.

Another tendency following on the military use of motors is the construction of substantial machines suited for regular use under very bad road conditions. Vehicles primarily intended for use on smooth highways depreciate very rapidly if used on roads torn by shells and disintegrated by a constant stream of heavy traffic. High ground clearance becomes a necessity in view of the obstructions that may be encountered. A very adequate cooling system is also essential, and, in fact, in most important respects, the military vehicle is closely akin to what is often known as the Colonial model. Thus, its enforced construction in quantity encourages the great national motor industries to build not only for their own countries, but for younger lands where roads are less adequate and facilities for motor maintenance less perfect.

In itself, the demand for military vehicles does not at normal times have any very great direct bearing on the size of the aggregate production of the industry. It is not the practice of governments in time of peace to take possession of large numbers of lorries for the

service of their armies. The more usual plan is to adopt a scheme of subvention or subsidy. Under such a scheme, the owners of vehicles of suitable types employed in civilian work are paid an annual sum so long as the vehicles are submitted to periodical inspection and found to be in good serviceable condition. In return for this payment, the owner of the vehicles contracts to sell them to the Government in the event of national emergency at pre-arranged prices depending upon their first cost and age. Thus, at a moment's notice, the Government can take over large numbers of suitable machines without being compelled perpetually to incur the cost of the purchase and maintenance of huge fleets.

Subvention schemes along these lines had been in force in Great Britain, France, Germany, and Austria for some years before the Great War. They had not, however, sufficed to bring into existence fleets of military vehicles numerically adequate to meet all requirements. Consequently, what actually took place was a widespread process of commandeering all sorts and conditions of machines of about the right carrying capacity. These served their turn well enough during the first few months of the war, and were as rapidly as possible replaced by more standardised products turned out by works, the output of which was wholly taken over by the various governments. From first to last, Russia, having no considerable motor manufacturing industry, was severely handicapped by lack of an adequate supply of transport vehicles. All that could be done in her case was to import in quantity from every possible source.

As applied up to the present, Government subvention schemes have not had the effect of largely increasing the use of motors in time of peace. The attraction of the subsidy has been more or less balanced by the fact

that the machines built to comply with the official specification were apt to be expensive as regards first cost. However, the influence of the Great War will be felt for a long time to come in this connection. Subvention type machines, or other types approved for military service, have been standardised and made the chief or sole product of numerous considerable factories. Increased production has led to decreased cost. Governments will no doubt continue to adjust the subsidies they offer to the conditions that rule. If the number of available machines is inadequate, the inducement must be made considerable. If the number is more than adequate, the inducement can be—and no doubt will be—comparatively trifling, since the power of commandeering on emergency always remains.

The development of motor forts or "Tanks" serves to indicate that from now onwards the military powers will have to take full responsibility for the development of certain motor machines, which would be of little or no use in civilian work. This can only be done either by construction in Government factories or by direct purchase. The latter method will probably be found the better. Experimental work will have to be carried on, particularly, no doubt, in connection with chain-track machines and tractors in which the engine power is transmitted to all four wheels. While these special types are of the highest military importance, it is not to be anticipated that, numerically speaking, their existence will influence the output of the motor industry to any very great extent.

Altogether, then, the military motor, while absolutely essential, and while affording the finest of all examples of the vital importance of the motor industry, makes its influence felt not so much by increasing the total demand made upon the industry as by directing its energies into certain defined channels.

CHAPTER XII

VARIOUS ROAD VEHICLE DEVELOPMENTS

While the staple product of the world's motor industry as a whole consists of vehicles fitted with internal combustion engines, the power of which is transmitted to the road by mechanical means, there are other developments which are fully deserving of specific mention. First among these comes the steam vehicle. In the early days, numerous attempts were made to design steam cars to compete directly with petrol cars for ordinary touring and private purposes. The main difficulties experienced were in connection with the generators for supplying steam and the burners for heating the generators. While great progress was made in some directions, the steam vehicle, as a class, was not successful in competition with the petrol car. This statement refers to the lighter classes of motor vehicle. Among industrial vehicles of the heavier types, the steamer still occupies a prominent position in some countries, and particularly in Great Britain. It has been found possible to design steam omnibuses which continue to give good results on the London streets, and very great interest attaches to a type of steam chassis in which cheap solid fuel can be used without frequent and somewhat expert attention to fuel supply being necessary. In fact, some authorities predict an immense future for vehicles burning coke fuel fed by automatic means. At present, however, the best known forms of steam vehicle are dependent upon hand firing.

The steam lorry in its commonest form is designed in two sizes to carry loads of 3 and 5 tons respectively.

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The boiler is of the locomotive type, the engine being mounted above it. The wheels are sometimes shod with solid rubber tyres, and sometimes with steel tyres. The steam lorry can conveniently be used to draw a trailer in which an additional load amounting to 2 or 3 tons can be carried. The advantages of the steam engine are its ability to develop power at low speeds and its comparative independence of anything in the nature of a change speed gear. Its disadvantages are its dependence on somewhat bulky and weighty supplies of fuel and water, and the fact that some time must be occupied in getting up steam before the day's work can be started. To these must be added the tendency to emit smoke and visible vapour, which in practice cannot be avoided under all circumstances.

There are many varieties of the type mentioned as a standard. In some, vertical boilers are used, and in others the boilers are placed transversely and are double-ended. These types are preferred by certain makers as occupying less space than the locomotive boiler, and consequently leaving more room for useful load. Then again, the engine is in certain instances mounted vertically to the rear of the boiler, and in others is of the horizontal type and situated below the floor-boards. The steam lorry is essentially a British production, and has really been developed from the road or traction engine with a view to the production of a substantial carrying vehicle of no undue weight, and not liable to cause serious injury to roads that are reasonably well-constructed.

Another and even more direct development from the road engine is the steam tractor. This again is essentially a British product. It is practically a traction engine in miniature, and provided with a more or less adequate springing system. It does not carry any load

but will haul about 6 tons upon a trailing vehicle. There also exist tractors taking their power from internal combustion engines, but up to the present these are not extensively used except for special purposes connected with agriculture or with cross-country haulage.

Under certain circumstances, the tractor method has noteworthy advantages over the self-contained vehicle. The chief of these is its ability to detach itself completely and rapidly from its load. The power of the engine can always be applied to a wire rope carried upon a drum. When in difficulties on heavy ground or an exceptional gradient, the trailer is unhitched and the tractor proceeds without its load to a more tenable position. The wire rope is then let out and hitched on to the trailer, and the engine power applied to the drum. The loaded trailer is in this way drawn slowly, but with great certainty, out of its difficulty, the wire rope giving a big mechanical advantage.

Under certain operating conditions, the tractor is also at an advantage as affording a means of eliminating waste of time that would otherwise be lost in loading and unloading. If the work consists of regular return journeys between two definite points, three or four trailers may be used in connection with one tractor, though only one is drawn at a time. While the tractor is on the road with one trailer, the second is being unloaded at one end of the journey and the third loaded at the other end. Thus, when the engine reaches its terminus, its trailer can be unhitched and another ready loaded is waiting for it. By these means, the engine itself is kept steadily at work throughout the day.

Another possible source of power for motor vehicles is to be found in electricity. For a service of omnibuses,

plying along a fixed route, electric current can be supplied from an overhead system of wires. The vehicles used in this connection are known as "trackless trolley cars." They suffer from most of the disadvantages of the tram-car and do not share all its advantages. More commonly, the electric vehicle carries a storage battery. This is charged at an electric power station, and subsequently supplies current to electric motors which drive the vehicle. The disadvantages are the weight of the battery, the limited radius of action due to the fact that the battery can be re-charged only at a central station and the process takes time, and the loss of efficiency between charge and discharge. The advantages are great silence and smoothness in running and in acceleration, and extreme ease of operation and simplicity in daily maintenance. Clutches and change speed gears are eliminated, and the electric motor is very dependable and seldom needs attention. The principal field of the electric vehicle is in the work of retail delivery of goods in urban areas, in its use as a town carriage, and in various classes of municipal service. The last named offers considerable opportunities, because the municipality is itself as a rule the owner of an electric power station, and so can obtain current for its vehicles at cost price. The electric vehicle is essentially a development due to the United States, though examples have originated in Great Britain, France, and elsewhere. It is only in the States that electric traction on common roads has up to the present figured with any great degree of prominence. In Great Britain and elsewhere, the use of electric vans has increased somewhat, but the number in employment is trifling as compared with the number of petrol-driven machines.

Intermediate between the petrol and the electric

vehicle comes the petrol-electric type. In this, the petrol engine drives a dynamo which generates electric current to be supplied to electric motors which drive the car. The dynamo and motors take the place of the clutch and change speed gear, and sometimes eliminate also the differential gear. In some designs, a small storage battery is carried to increase the power available on steep hills. In general, however, it is considered that the additional weight and cost of the battery more than neutralise the advantages obtainable from it.

There are many forms of transmission which for convenience we are grouping together under the general term—"petrol-electric." In some, the engine merely drives the dynamo and the transmission is purely electrical. In others, the transmission is sometimes or always wholly or partly mechanical, and only in part electrical. In some again, magnetic phenomena figure prominently. Up to the present, petrol-electric vehicles have established themselves to a satisfactory degree in certain particular spheres. In public service, electric transmission commends itself for omnibus work, provided that the costs of operation can be kept down to those of the petrol omnibus. For certain classes of military work, as for example, for the carriage and operation of searchlights or wireless telegraphy outfits, the advantages resulting from the presence of what is in fact a small complete electric power station are obvious.

Brief mention should be made of certain forms of hydraulic transmission, in which a series of pumps takes the place of mechanical gears, means being generally provided for varying the throw of the pumps. At present, there are very few vehicles with hydraulic transmission on the road, and the whole development cannot be said to have passed the experimental stage.

CHAPTER XIII

THE MOTOR IN AGRICULTURE

UNDOUBTEDLY, one of the biggest fields for the extension of the motor industry is in connection with agricultural operations and the carriage of farm produce and supplies. Up to the present, this development has to some extent lagged behind other sections of the motor industry. Where hard roads are available, the carriage of produce and supplies is merely a matter of the use of motor lorries or tractors of suitable capacity. The design of a machine for field work, however, involves consideration of very special problems, which are to some degree accentuated if the only communication between farm and market or railway is by dirt road or by unmade tracks.

The maker of an agricultural motor intended to tackle any or all of the work of a farm has a very difficult problem before him, and it cannot be stated that up to the present this problem has been completely solved. Consider for a moment the essential differences between this class of work and that which has to be done by the average car or lorry. The farm motor must be suitable for hauling a great variety of implements on the land or a considerable load along the road. One of its principal jobs is that of hauling the plough. In this work, it must develop its power at a very low speed of travel, and must be capable of going on working under full load without any appreciable rest hour after hour and day after day. No car engine, unless racing or record breaking be indulged in, is subjected to any such severe test. It is only on occasions that the

The Ivel in the Field

The Mann Threshing

motorist is able to develop his full speed or requires his full power. At other times, his throttle is partly closed and his engine is working well below its maximum capacity.

We have mentioned that the tractor must not only develop full power continuously, but must do so at a low speed of travel. This increases the difficulty of engine cooling, and also involves very substantial transmission in the neighbourhood of the back axle. High power can be developed through the medium of quite light transmission, provided that high speeds are attained, but, if high power must be developed at low speeds, the stresses in the transmission are great, the material must be of the highest class, and the weight of material used must be considerable. These considerations serve to show how difficult it must be to produce a really good farm tractor at a very low cost, and yet a low cost is one of the first essentials. Then again, the tractor ought to be very simple in operation and very easily kept in running order. Expert mechanics cannot be available at all points on a farm, and delays due to temporary breakdown are very inconvenient and neutralise one of the greatest advantages of the motor tractor. This advantage is its ability to do its work comparatively quickly, and so to get it done while the weather is just right. The ideal tractor should be suitable to be handled by the agricultural labourer of average intelligence, but with no great mechanical knowledge. It must not be dependent on delicate adjustments, or susceptible to a certain roughness and crudeness of treatment. While it must be very free from features liable to necessitate running repairs during the day, it must be almost equally independent of that regular skilled attention which falls to the lot of every properly-maintained road vehicle. Generally

speaking, in fact, it must do harder and rougher work than any other class of motor, and must do it without giving trouble or requiring skilled attention except for a periodical overhaul which must become necessary only when a slack period of the year makes it convenient.

Much of the development of agricultural motors up to date has been due to the United States. Here, however, matters were hurried too much, and inferior design and construction, coupled with doubtful selling methods, led to very many failures, and this despite the fact that the cultivation of huge open areas of land, such as are found in the United States and in the British Overseas Empire, presents a much easier problem to the farm motor manufacturer than does the cultivation of land under conditions obtaining, for example, in Britain and France. On big open tracts over which powerful engines can be employed to plough six, eight, or even a dozen furrows at a time, the machine may travel for miles without having to turn, and the depth of ploughing need not, as a rule, be very great. On the other hand, the average English farm is cut up into small fields. The furrow is of no great length, and frequent turns have to be made. It thus becomes very important to be able to turn quickly, and not to leave any considerable amount of headland unploughed. Land is valuable, and must be utilised to the full. Cheap ploughing is therefore necessary. Stiff gradients are common ; also, awkward entrances to fields from narrow lanes. Fur ther, the consistency of the soil varies very much, both stiff and light land often being found on one small farm. The use of very large tractors under such circumstances would be clearly inadvisable, and it is probable that there will never be any great demand under such conditions for tractors capable of ploughing at one time anything more than three furrows about seven inches

deep. It frequently takes only a few hours to complete one field. The tractor must then move along a public road to the entrance of another field. It must not damage the road, or its owner will be liable to prosecution. Consequently, any fittings attached to its wheels to enable them to get a good grip of soft soil while pulling the plough must be capable of being attached and detached in a very few minutes.

Under all circumstances, the designer of the farm tractor has to remember that his engine must not compress the subsoil unduly. He must, therefore keep down the weight as much as possible, but at the same time he must secure such good adhesion as to make his tractor useful even under the worst conditions when the ground is very greasy, or has been recently manured.

Altogether, the conditions in Western Europe are so different from those obtaining in younger countries as to make it improbable that tractors designed in, and primarily for, the latter, will ever become really popular in the former. On the other hand, if British and French engineers put their backs into the work and succeed in solving their own problem, they will, in producing something good enough for their own countries, have more than solved the problems facing the farm tractor maker in other lands. All that would then remain for them to do would be the production of larger models to do the work on a bigger scale. Meanwhile, as already indicated, the main problem of the United States manufacturer with reference to his home market is not quite so complex, and is similar to that of many other countries where agriculture is a staple industry. Under these circumstances, it is difficult as yet to predict what in the future will be the main sources of supply of agricultural motors to meet the world's demand.

Up to the present, there are a considerable number of

types represented. The design of the very large tractors does not in general involve any very special features. A powerful engine drives through a simple clutch, and a two or three-speed gear transmits its power to very wide driving wheels furnished with strakes or spikes. If haulage on hard roads be contemplated, the springing system must be good ; otherwise, it is often neglected.

Perhaps the biggest demand is likely to be for a tractor of about 20 to 25 horse-power, capable of ploughing three furrows to a fair depth in average soil, and of driving a threshing machine or grain elevator. There are many examples coming into this category. Here again, simplicity is the key-note of most designs, but there are too many in which durability and true efficiency are sacrificed to the desire for low first cost. It is possible that the chain track system, as exemplified in the " Tanks " and in the " Caterpillar " tractors, will make great headway in the sphere of the farm motor. It offers great possibilities of good adhesion without undue compression of the soil. There are other ingenious ways in which skidding and slipping on greasy surfaces are avoided. Particularly in France, attention has been devoted to the design of machines driving cultivating implements to take the place of the ordinary plough. These implements revolve round an axle, gear-driven from the engine. As they enter the soil, they not only break it up, but help to push the tractor itself forward and so to prevent slipping. In other instances, implements closely akin to the ordinary plough coulter are carried on endless chains set diagonally from the sides to the rear of the machine. The result is not neat, but may be effective ploughing.

A scheme tried in France is a sort of half-way house between direct ploughing and the old method employed by steam ploughing engines. In this case, the tractor

carries a long wire rope wound on a drum. It runs light across the field to the extent of its rope, the loose end of which is then attached to the plough and the engine power applied to drag the implement up to the tractor. The method involves loss of time, but permits of the use of a comparatively light machine to do heavy work.

A very ingenious class of self-contained motor plough has been developed in Great Britain. In this, the engine really takes the place of the horses, and the machine is balanced about a single pair of wheels, with the engine at the front and the ploughs at the rear. Clever mechanism allows one of the driving wheels or chain tracks to be lowered into the furrow last turned, while leaving the machine as a whole on an even keel. These little ploughs will often do good work on greasy gradients where the ordinary farm tractor would be in difficulties. They are also very handy in confined spaces, such as market gardens, hop gardens, and orchards. Up to the present, the use of farm tractors represents only a trifling percentage of the potential use. The possibilities for the extension of the motor industry in this direction are almost infinite.

CHAPTER XIV

APPLICATIONS OF MOTOR ENGINES

THE internal combustion engine designed to use a light type of fuel is essentially a product of the motor industry. Consequently, if, as is undoubtedly the case, such engines are required not only on vehicles but in other spheres, the output of the industry will be thereby increased. No industry can be regarded without any reference to a group of other industries which necessarily overlap it. Thus, in the case of the motor industry, we have a natural overlapping and linking up with the aircraft industry, the marine engine industry, and the stationary internal combustion engine industry.

The aircraft industry is dependent on the production of high powered petrol engines of distinctive type. High duty and low weight are first essentials, and the engine must be capable of operating with great certainty at a uniform speed for long periods. It is possible, and indeed probable, that as time goes on the design of aero engines will become more and more distinct from that of motor car engines. The popularity and success of certain rotary and radial types of engine on aircraft indicate quite clearly this possibility. Nevertheless, it is highly improbable that the aircraft and the motor industries will ever become altogether dissociated from one another. For a long time to come, the aircraft industry will be mainly dependent on the fact that aircraft are essential in warfare. The Government of every great country must necessarily, even in peace

time, maintain large fleets of aeroplanes. There are possibilities also in connection with postal services, and even with passenger transport in sparsely populated open countries, where railways are economically impossible and suitable landing grounds are frequently available. There is also the sporting element to be reckoned with, but when all is said and done it is as a weapon of offence and defence that the aeroplane must at present be viewed. From this it follows that the demand existing in any country for aeroplanes and aero engines will be immensely increased in time of war, both because the regular establishment must be enlarged and because of the inevitable wastage.

Now it would not be sound policy to keep in existence shops earmarked definitely and solely for the manufacture of aeroplane engines in quantities vastly in excess of the normal requirement. Consequently, we may expect, in every country that claims to be a military or naval power, to see a permanent aircraft industry established and maintained on a scale only slightly more than sufficient to meet peace time requirements. National policy points to the advisability of arranging that some at least of the engines required for the country's aircraft fleets in times of peace shall continue to be manufactured in motor works, perhaps as a minor section of the normal activities of such works, but under conditions which would make it possible in emergency to increase immensely the output of aero engines at the expense of some other class of output far less essential from the military point of view. The Great War has shown that the production of motor lorries can hardly be excessive. The whole output, however huge, can almost certainly be taken up for military service. It is not therefore desirable to make any arrangements which would decrease the output of motor lorries in

war time. On the other hand, assume a considerable industry engaged in the manufacture of private motor cars and motor cycles. It would be possible without jeopardising national interests to reduce the normal output of these products in times of emergency. It is advisable, therefore, that selected firms of this class should continue in peace time to be given Government contracts for the supply of aero engines, such contracts being placed in view of their ability to increase the output very rapidly and considerably when required to do so.

For the reasons detailed, it is wise national policy to recognise a close connecting link between the motor and aircraft industries and not to allow them to separate out too completely. We are therefore justified in including mention of the aero engine within the scope of this book, not merely because such engines are now largely built by motor manufacturers, but because circumstances point to the necessity for rendering this condition permanent.

The motor car engine in modified forms also fills a big demand in connection with the power plants required for launches and small boats. The internal combustion engines of larger vessels are of a different class, and are the products of the gas- and oil-engine industry. Even among the small engines used for marine work we find a strong tendency towards the universal employment of comparatively heavy fuel of the petroleum order. This makes for safety and also for economy, and as time goes on petrol will be less and less used for any such work. The two-stroke system is also popular in launch and boat engines, and, unless this system gets adopted on motor vehicles, this fact is another reason for differentiation, and perhaps for ultimate separation of the two industries. At present, however, the very

small engine generally runs best on petrol. High speed river and estuary launches often have engines indistinguishable in design from those of motor cars. The petrol engine is also convenient for use as an auxiliary on sailing yachts and for very small installations on little launches and dingheys.

Brief mention should be made of what is known as the "outboard" motor. This is, in fact, a small self-contained power plant that can be attached to the stern or side of a sailing or rowing boat. It consists of a one- or two-cylinder engine generally working on the two-stroke principle, driving, through a vertical shaft and gear, a propeller of the reversible type, or so arranged as to swing round to give a reversing effect. Outboard motors have been found very useful for auxiliary purposes, and also for yachts, dingheys, and the like. Often, however, some local strengthening of the hull is necessary before they can be used efficiently on ordinary rowing boats. Although rather in the nature of a makeshift, it is probable that outboard motor sets represent a permanent, if not a very important development of the industry.

The engines of motor cars or industrial motor vehicles can, with very slight modification, be employed to advantage for stationary work of various kinds. A simple low-priced engine transmitting its power to a substantial pulley is very useful for performing all sorts of small jobs about a farm or country estate. The demand in this direction is already considerable, especially in the younger countries, and will increase still further as animal power continues to be replaced by mechanical power in agricultural districts. Stationary engines of the motor class can also form part of self-contained installations for electric lighting or for pumping. In the former connection, a fair market is

likely to continue to be available in view of the requirements of fairly well-to-do dwellers in the country. A number of other applications of motor engines used alone or in conjunction with other machinery will suggest themselves.

We have now covered with some degree of completeness, if in a rather cursory manner, the products of the industry, and may turn to a brief consideration of the methods under which those products are manufactured and marketed.

CHAPTER XV

EUROPEAN AND AMERICAN METHODS COMPARED

In setting out to compare national methods of manufacture and sale of the products of the motor industry, one must necessarily generalise. What we shall describe as the American method is not that of every American manufacturer, and what we shall describe as the European method is subject to many variations, and is by no means unchangeable. Despite exceptions that may be fairly numerous, and variations that could only be separately discussed at great length, we shall take it that what is commonly understood to be the American method aims primarily at production in very large quantities, with a view to manufacture at the lowest possible price consistent with the design and quality determined upon. The European method, on the other hand, does not make minimum price its first and main object. It aims principally at production in comparatively small quantities of products noteworthy for their individuality and for their distinctive merits.

At the bottom of this broad difference of method is the underlying fact that the American home market is enormous in extent as compared with the home markets of European countries. The extent of the American market is undoubtedly due in some measure to the very low price of some American cars, but is due in a still larger measure to national conditions which cannot be moulded by any motor industry however enterprising. It does not in the least follow that what

A Standard Two-seated Light Car

A Ford Four-seater

was the right policy for the American is also the right policy for the European manufacturer.

As an outstanding example of American methods, let us consider briefly the practice of the firm which produces far more cars in the course of a year than does any other manufacturer. This concern has a huge main factory in the United States, and from time to time establishes elsewhere large factories which are in the main assembly shops. The first principle is to determine upon and adhere to one standard design of chassis, which makes possible a big outlay on specialised tool equipment. Changes of design may necessitate sweeping changes in this tool equipment, and to this extent quantity production may impede progress in design. The second principle is, by comprehensive and effective sales organisation, to maintain production constantly at its maximum figure and never to carry any considerable stock of cars, but rather to deliver the factory's output day by day as it is produced. Thirdly, we have another fairly obvious principle; namely, to make the lay-out and arrangement of the factory such that the work passes steadily round without having to be transported over comparatively long distances between one operation and the next. Fourthly, production in huge quantities renders possible purchase of raw materials on a very big scale, and consequently in the cheapest possible market. It is also claimed for the methods of this factory that any substantial improvement is adopted as soon as it has proved its merits, whatever may be the expense involved. Despite this claim, there still remains the strong probability that a real but slight improvement will not be so readily adopted in a factory of this size and class as it would be by a smaller concern aiming at individuality and constant refinement and progress

rather than at high standardisation of method and product.

In this and other American factories, a car that is being assembled moves steadily from point to point, each man doing his own particular job upon it as it passes him. In the European method, the man goes to the car and not the car to the man. It will be seen that in the American method, no workman need be what we should call a skilled car assembler. He has his own particular piece of work and does nothing else. He is, in fact, almost a part of the machinery of the factory. Like a machine, he is engaged on repetition work, and he is employed to do those jobs that cannot conveniently or more economically be done by the machine itself. The tendency must in a sense be to crush individuality and resourcefulness, and to lead to a somewhat narrow outlook. Under this method, a man does not have to regard a car as such, but merely to regard a partially assembled chassis as a thing on to which he is to attach a certain fitting or component in a certain way at a certain point. One would imagine that men so trained would, just at first at any rate, be entirely at sea if their jobs were shuffled. In the ordinary way, no such shuffling is necessary, but we are trying to regard a national motor industry as a national asset. From this point of view, one of its duties may be to transfer its energies promptly from the manufacture of motor cars to the manufacture of some other war material. The American quantity method from this point of view would not be good as regards the machines used or as regards the *personnel*. It tends too much to produce automatons and too little to produce thinking men. On the other hand, it pays its men well and leaves them to do their thinking outside their working hours. There are those who believe that the

method, being soulless, though very perfect in its own way, will sooner or later fail as a result of a lack of individuality and animation. One does not see why this should occur as long as things are normal, though one can easily realise the weakness of the position if abnormal circumstances had to be faced. The argument is to some extent akin to that which has often been applied to the German war machine, which, so long as it can work according to plan, is extraordinarily efficient, but which, when deranged by some external cause, feels the shock more severely than would an organisation, looser, and in some respects less perfect, but possessing more inherent vitality and personality.

The time has gone by when we could advocate hand labour as against the use of machines, but nevertheless we still cling—and perhaps rightly so—to the idea that in certain ways the products of a skilled man's hands can never be quite equalled by the products of automatic machinery. A comparison between hand labour and machine work cannot be fairly used as a comparison between European and American motor building methods, but the fact remains that the former is far more dependent than the latter upon the skilled man, and that in some subtle way the product bears witness of this fact. Any machine must in essence be inanimate, but men grow fondest of machines which seem to have some character and life of their own. The driver of a railway locomotive, like the master of a ship, does not describe his charge as "it" but as "she," indicating that to him the vessel or the machine possesses a personality and makes an appeal to his affections. There are many motorists who will sympathise with what is meant when it is suggested that the quantity car is "it" and the quality car is "she," and that the second

pronoun can never be applied to a product of the methods that make quantity and minimum cost their great and almost their sole aim.

As to the influence of quantity production on cost, there can be no question. It is said with good reason that when once production has reached and exceeded a certain considerable figure, the works cost of each product cannot be further reduced by further increasing production. Works cost, however, is not the only item. We have to take into account the business organisation that sells the car, and the service organisation which looks after the car and its owner when the first transaction is complete. Economy in the cost of selling is dependent on the quantity to be sold. Here, there is no limit to the possibilities of improving economy by increasing output. The same applies to any organisation that may be designed to give service in respect of the vehicles already upon the road. A manufacturer who produces in small quantities cannot afford to support a complete and perfect selling organisation in all parts of the world, and through it to keep in close touch with his agents and their customers. If we estimate that a complete selling organisation involves a certain number of individuals located in a certain number of districts, then when we come to divide up the cost of the organisation and to charge a proper proportion of it against each car, that car will come off lightest that is sold in the biggest quantities. Thus, the first and greatest advantage of quantity production is its effectiveness as a means of lowering cost.

A secondary advantage of quantity production intelligently directed is that the necessity for finding wide markets for large numbers of vehicles makes it also necessary to specialise on a product which does not appeal only to one or two countries, but is in a fair

degree at least suitable for use in all parts of the world. Admittedly, any such attempt may lead to a compromise which will affect the perfection of the product as employed in any one specified area. On the other hand, it overcomes a tendency which is noticeable among many manufacturers working on a smaller scale. This is to design and construct with an eye to one particular market, and to that one alone, but to sell when opportunity arises on other markets where conditions are distinctly different, and where consequently a vehicle approaching perfection in its own area may well prove a comparative failure.

Now as to the advantages of production on a smaller scale aiming primarily at quality. First of all, we have that subtle difference in the character of the product that we have endeavoured to indicate above, a certain life and individuality which shows the close connection existing between the machine and the human being. Next, we have the fact that each manufacturer, working under this latter system, is subject to keen competition, and must, if he would survive, develop and incorporate in his car features of outstanding merit. This stimulates invention and research, and prevents stagnation in design. The significance of this assertion can best be demonstrated by going to extremes. Imagine the whole car trade of the world to be in the hands of one manufacturer, and there remains very little inducement to that manufacturer to incorporate slight improvements in design, any one of which would involve enormous expenditure on new machines for repetition work. The stimulus of competition would be absent. Even if we do not go quite so far, we must admit that the principle of quantity production, taken to its logical conclusion, very much reduces direct competition among manufacturers producing more or less equivalent

products. Low first cost is apt to become a fetish, and to be put forward as the chief, and almost the only, selling point. On no account must the cost be allowed to rise, for, if it be permitted to do so, the edges of the market will be cut away by the next manufacturer up or down the scale of prices. With the question of coach-work, and the difference between a car body made to order and a ready-made body, we shall deal in a subsequent chapter.

Generally speaking, what has been written on the subject of car production may be applied also to the motor cycle industry. In the sphere of the industrial vehicle, however, there are certain distinctive circumstances which ought to be mentioned. Here, less importance attaches to individuality or vitality in the vehicle. What we want is something reliable, durable, and capable of regular work under heavy load. This points to quantity production. On the other hand, we find in practice that there is a wide variety in the requirements of different trades. To some, speed is extremely important ; to others, carrying capacity is the principal consideration. Others again require a compromise between the two extremes, but there is variation needed in the compromise itself. So far as body design is concerned the requirements of different trades are even more distinct, but this we shall touch upon later. We must remember, too, that, while the public service vehicle and the goods-carrying vehicle of similar load capacity are closely akin, approximation to the ideal in each case does not necessarily point to the production in quantity of one standard type for the two purposes. Steady acceleration and freedom from jerks and noise are far more important when passengers are being carried, and special modifications and additional expenditure with a view to securing these qualities may

perhaps be justifiable in constructing the chassis of a public service vehicle, but not in building a machine for the carriage of goods. Then again, there are certain peculiar requirements connected with military service, as for example, the provision of sprags and radiator guards. Up to the present, quantity production has not gone so far in the sphere of the industrial vehicle as in that of the private motor car. Considerable further development in the direction of quantity may, however, be confidently expected.

CHAPTER XVI

STANDARDISATION AND THE ASSEMBLY OF STANDARDISED COMPONENTS

THE subject of standardisation is inextricably mixed up with that of quantity production, and also with such questions as the possibility of co-operation among manufacturers and the relative merits of complete manufacture in one factory as against assembly of a number of standardised components. Any divisions that we may make in this branch of our subject must therefore be rather arbitrary, and the contents of this chapter should not be considered separately from those of the chapters which precede and follow it. There are several points of view from which to regard standardisation. First, we have that form of standardisation which means in the result proper interchangeability of the corresponding parts of chassis of any one type turned out from any one factory. In the extreme instance of lack of standardisation, we should find that no two chassis produced in a particular shop were exactly alike, or sufficiently similar to make it certain that spare parts would really fit. Vehicles so produced would really be a series of experimental machines, the cost of each being immensely greater than is in any way necessary or justifiable. We thus see that manufacture, if the word be used in what is now its common sense, naturally entails some degree of standardisation, each type produced being for the time being standardised in the works.

The next step is to standardise certain parts to be

common to a variety of types all turned out by the same factory. Thus, the same back axle might be standardised for an omnibus chassis, a 3-ton commercial chassis, and also a 2-ton commercial chassis. The strength of the axle might be a little greater than was necessary for the lightest of these types, but it would cost less to adhere to the standard than to produce a special model for each type. Then again, if 12-horse, 24-horse, and 36-horse chassis are produced in the same works, the same cylinder castings may do for all of them, the vehicles being fitted with 2, 4, and 6-cylinder engines respectively. In this case, the valves, pistons, and connecting rods would also be standardised for all three models.

Next, we have the principle of increasing the degree of standardisation possible within one factory by decreasing the number of types produced. In the extreme instance, the whole factory is devoted to the production of only one type. This is what is known as the "one-model" policy. In certain cases, it has proved remarkably successful, both from the point of view of the manufacturer and from that of the public. It ought to be possible by decreasing the number of models to give better value in respect of the one upon which the whole energy of the works is concentrated, because all the parts are produced in considerable, if not in immense, quantities.

Then we come to standardisation as between groups of manufacturers. When this occurs, it is frequently brought about not so much by the car manufacturers themselves as by other firms that specialise in the production of certain components. Take, for instance, some big concern that produces magnetos for ignition purposes. By achieving huge output, this concern is able to give very good value for money. If successful

in obtaining the custom of a large number of car manufacturers, it is enabled to standardise its own product, and to enforce on its customers a corresponding degree of standardisation among their complete productions.

Take, again, the case of a firm manufacturing engines on a large scale and supplying a number of car manufacturers. The British practice in this connection has, as a rule, been for the car manufacturer to dictate the design of his own engine at any rate to some extent. Thus, the engine manufacturer cannot fully standardise a single engine of a single power, but has to embody certain features to satisfy individual clients. It is still possible for him, however, to standardise in a measure, so that while, say, the 20-horse engine supplied to one firm of car manufacturers by him differs materially from the 20-horse engine supplied to another firm, the two have certain parts in common, and lower costs of production become possible in respect of those parts. In America, the regular practice in this connection has been rather for a group of car manufacturers to agree to accept one model of engine. This enables the engine manufacturer to standardise to a much greater extent than would be possible were he subject to dictation as to variation of details. The essential difference in principle lies in the fact that, under the American method, the impetus in favour of standardisation comes from the car manufacturers who can go as far as they wish in that direction, while under the British method the impetus comes from the engine manufacturer who can only standardise so far as his clients will permit it. The relative position in respect of the manufacture of other components, as for example, gear boxes and axles, is rather similar. Thus, we find that many American vehicles bearing different names are in their principal features identical with one another,

consisting as they do mainly of a number of highly standardised components brought together. The car producer's shop is then, in fact, devoted to assembly rather than to true manufacture.

This substitution of assembly for manufacture only recommends itself to a very limited extent to any national industry which is accustomed to regard individuality as of very high importance and value. Where the scheme is thoroughly applied, what it amounts to in practice is this. There are a number of shops more or less allied to one another, each of which specialises on the manufacture of one or two highly standardised components in very large quantities, and consequently at the lowest possible cost. With this group are associated a number of other shops whose main business it is to put together these standardised parts, to add a few minor parts which may give some measure of individuality to the finished product, and then to market that product. The method has some of the advantages of big quantity production in a single factory, or in a group of factories owned by a single firm. Other of these advantages it lacks, because it still leaves the selling organisation to be carried on by a number of comparatively small concerns working separately and consequently incurring a higher selling cost in respect of each car than would be involved were the whole of the business handled by one concern. The result is that this form of standardisation cannot go quite so far as can quantity car production in the direction of reducing costs. It commends itself, therefore, to the comparatively small manufacturer in a country where quantity production is the rule rather than the exception, and where low selling price is the principal selling point. It does not commend itself much to manufacturers in a country where quality production

prevails. It does not quite render possible equal competition in respect of price with the quantity producer, and it stifles or limits individuality, which, failing exceptionally low price, forms the basis of the principal selling points.

Intelligent quantity production entails automatically a high measure of standardisation, but it still leaves the door open for further standardisation of a somewhat different kind involving not only one industry, but many. In Great Britain, America, and elsewhere, there are organisations almost or quite official in character, the duty of which it is to fix upon standards in the interests of the engineering industries as a whole. The determination of such standards simplifies the business of the producers of raw material, and of certain small components used in all sorts of engineering products. Thus, for example, screw threads are standardised, not for one branch of our engineering industry, but for almost all branches. National standardising organisations are able to go further than this. By the establishment of expert committees, they can determine and insist upon the standardisation of certain dimensions and details. Thus, for example, they can settle the height of the armature shaft of a car magneto from the base-plate of the machine, and so make it possible for the engine designer to complete his design and decide afterwards what magneto he will fit, or change from one make of magneto to another and a better one. This form of general standardisation is all for the good, provided it is not taken so far as unduly to complicate and hamper the work of the designer.

Before leaving this branch of our subject, mention must be made of another form of standardisation within the motor industry. This is due to the desire of Governments to popularise certain types of motor

vehicles, possessing certain features in common, for the reason that these types constitute a military asset. Our best example here is to be found in the specification published by the British War Department two years or so before the outbreak of the Great War. Standardisation was not in this specification carried to such lengths as to kill individuality. It went far enough, however, to serve as a stimulus to uniformity in the arrangement of control levers and pedals, and in certain other respects. Encouragement to accept standardisation up to the required point was given by offering subsidies to the owners of vehicles built to comply with the specification.

We thus see that standardisation may result from pressure from various sources. It may come from within the individual firm, from a group of car manufacturers working together, from a group of component manufacturers, from the engineering industry as a whole, or from the Government. The degree of standardisation desirable and obtained must always remain a matter of compromise and discussion. Total absence of standardisation is fatal in an industry such as that under consideration. Complete standardisation in every respect would involve total suppression of originality and individual manufacturing enterprise, and would thus prevent progress. Somewhere between these two extremes lies the happy mean, but just where it is to be found depends on a great variety of factors, including the extent of the available markets, the fads and also the cultivated taste of the purchasing public, and the price that people are willing to pay for the possession of something distinctive, and not identical with that owned by all their neighbours.

CHAPTER XVII

CO-OPERATION

Co-operation among manufacturers in the motor industry may have for its object a decrease in the cost of raw materials, a decrease in manufacturing costs, a decrease in selling costs, or a combination of any or all of these. As regards the first, manufacturers may group themselves together with the object of placing very large orders for raw materials and so obtaining the most favourable terms possible. By accepting a measure of standardisation they may make it possible for their suppliers to specialise on the production of materials in a smaller variety of lengths, sections, or dimensions. Moreover, by working co-operatively, they may assure the supplier of a large minimum output, since he can safely base his calculations not upon the fluctuating fortunes of one firm, but upon the average of a number of firms. Thus, the price of materials used in motor car construction may be lowered without the supplier of those materials being in any way adversely affected. Up to the present, the principle of co-operation in buying has not been carried as far as one would have expected, seeing that it is perhaps in this sphere that the practical difficulties in the way of co-operation are least troublesome.

The subject of co-operative manufacture is very closely connected with the matters discussed in the last two chapters. If a number of firms get together to manufacture on effective co-operative lines, the consequence must inevitably be high standardisation of the resulting products, coupled with at least a partial

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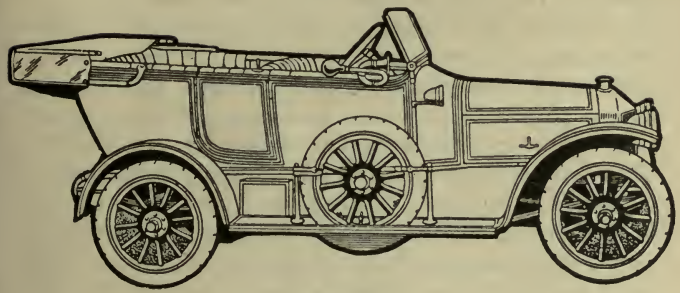
adoption of the principle of assembling from components manufactured in a number of works. Thus, any scheme of co-operation applying particularly to manufacture is naturally very closely allied to the method which entails the assembly of standardised components. If there is any material difference, it lies in the fact that the assembly method, as usually understood, involves the employment of firms that have from the first been mainly manufacturers of components, whereas the co-operative method more commonly involves a change in the organisation of works originally devoted to the manufacture of complete vehicles, but ultimately becoming mainly component factories under the co-operative scheme. It is quite conceivable that co-operation in manufacture can be brought about without co-operation in selling, but in effect, co-operation in manufacture means some measure of co-operation in the purchase of raw materials. Thus, if the whole supply of some particular component required by the entire group of manufacturers is, under the co-operative scheme, turned out from one factory, it stands to reason that that factory would previously have bought its raw materials in the bulk and not in comparatively small quantities.

Co-operation as applied particularly to selling appears to have endless possibilities. Any such scheme involves the association of a group of manufacturers not competitive among themselves. Such a group might be formed of a manufacturer of high-class motor cars, a manufacturer of light cars, a manufacturer of light commercial vehicles, another of heavy commercial vehicles, another of solid tyres, another of pneumatic tyres, and so on. This group might establish branches or agencies in common, thus covering the field with reduced cost to the individual firm. The scheme might

The Belsize



The Briton

TYPICAL TOURING CARS OF MODERATE PRICE

go further and include the employment of joint salesmen together with joint expenditure on publicity, and the issue of trade matter in the joint interests. One of the principal difficulties in this and other schemes lies in estimating the proper percentage of the whole charge which ought to fall on the shoulders of any one manufacturer in the group. The difficulty in this connection is still greater if the proposition involves selling co-operation among competitive firms, since the salesman, however honourable, must have his own preferences and opinions, and would therefore possibly not be equally successful in disposing of the goods of all his principals. A very high degree of mutual confidence among manufacturers is necessary to the success of any scheme of this kind. Failing it, there always remains suspicion that some one member of the group may be securing the cream of the trade by dishonourably offering special inducements to the selling staff.

When co-operation extends to the purchase of raw material, to manufacturing processes, and to selling organisation, very close relations among the various companies concerned are involved. It will be readily realised that the arrangements connected with finance become very complex, and the strong likelihood is that what started as co-operation ultimately becomes definite combination of interests, and the merging of the separate individuality of the various concerns themselves, though not necessarily of their products. This type of complete co-operation has up to the present been achieved with most success in the United States, and the results following from it have been notably satisfactory as compared with the results obtained by the firms individually before the combination was arranged. British manufacturers have not as yet shown themselves particularly willing to combine, or even to co-operate

heartily. They must not necessarily be blamed for adopting this attitude. It has been pointed out all along that the British method depends upon and demands distinctive individuality of products. The available markets are not big enough to encourage standardisation and quantity production on the lines favoured in the United States. Thus, the only course left open is to market a product which appeals less on the grounds of low cost than of distinctive merit. Now, the whole tendency of co-operation is in the direction of a levelling-up of quality. The writer is of the opinion that such levelling up need not necessarily be an accompaniment of co-operation, but that the tendency nevertheless cannot be denied. From this it follows that, in a country where cheap first cost of the car is the principal selling point, co-operation is easier to achieve than in a country where the main key-note is distinctive merit. Where co-operation or combination has at present been most successful, it has existed between the manufacturers of cars quite different from one another in certain essential respects, but all aiming more or less at what we may call the American ideal, which entails giving *evident* value for money and not asking a comparatively high price for an article, the high value of which may not be obvious by its completeness, power, and size, but may nevertheless exist in a less tangible form. Only those who appreciate the differences from the driver's standpoint, that exist between cars of similar power and similar general features can quite realise the point that the writer is endeavouring to make here.

As regards the future of co-operation, there can be no doubt that the principle will gain ground, and that its practical applications will be multiplied. In Great Britain, which has been essentially a country of

individualists, there is now a marked tendency towards the acceptance of co-operation in principle, and this will certainly lead to some degree of acceptance in practice. Even co-operation in principle is a step in the right direction and may prove very effective. An industry which is organised so that it can agree upon a general policy and push that policy forward with all its strength has in it the elements of a power in the land. Particularly, it may hope to receive the sympathetic support of its national government, which is more influenced by the collective action of a big group of interests than by the individual action of all the components of that group working separately. Thus, co-operation on matters of general policy has the effect of changing a crowd into an army, and thus immensely increasing its power. By coming together among themselves for the discussion of matters of policy and such-like, manufacturers arrive in a position from which it is comparatively easy to embark upon more practical co-operative schemes. Moreover, being agreed as to what their government ought to do for them, they are faced with the criticism that they cannot expect external help unless they help themselves by re-organising the internal affairs of their industry. Realising the advantages resulting from government assistance and the goodwill of the public, they become more disposed to sacrifice their own individual advantages, owing to an acknowledgment of the fact that in the end what is good for the whole industry will be good for the individual, even though for the time being the individual may to some extent be handicapped by voluntarily relinquishing some measure of his independence.

CHAPTER XVIII

METHODS AFFECTING BODY DESIGN AND CONSTRUCTION

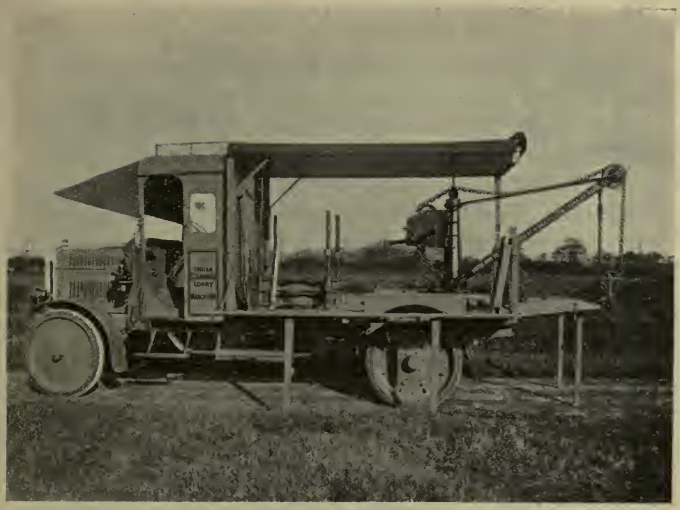
MANUFACTURERS who turn out cars in large quantities have found it advisable to give full adherence to the principle of supplying them fully equipped in all respects, so as to be ready for immediate use without the addition of further fittings. From the point of view of the quantity producer, there is everything to be said for this method. For one thing, the phrase " Ready for the road " has proved a very valuable selling point, and, by comparison, a means of criticising adversely the extreme alternative method, which is to sell the chassis as such and subsequently to fit body and accessories to the taste of the customer. The man who buys a car " ready for the road " knows exactly what initial expenditure he has to incur, and this is the reason why the phrase appeals so strongly. Another advantage is that the method facilitates standardisation not only of chassis, but of body and of all accessories and fittings, and this in turn leads to an all-round reduction in cost. If the manufacturer of the " ready-for-the-road " car were to consent to sell a single chassis at its fair price, the purchaser of that chassis would never be able to get it equipped at such a figure as to make the total cost as low as that offered in respect of the standardised " ready-for-the-road " car.

On the other hand, the " ready-for-the-road " method limits the purchaser very much as to the type of his car body, and as to the make of his accessories and the quality of his fittings. He cannot consult his own

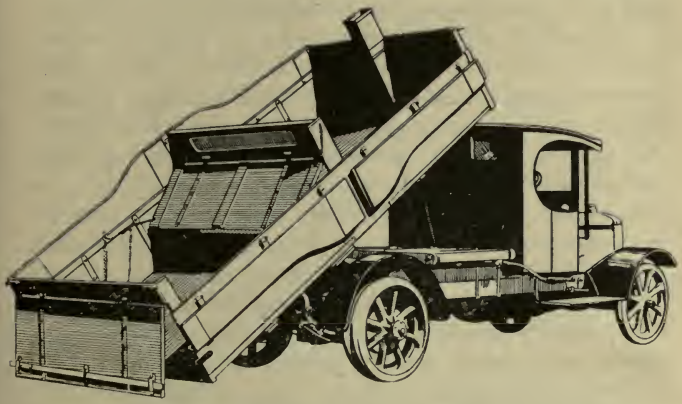
taste, and depart from the standard arrangement. Incidentally, the "ready-for-the-road" car is very easily identified. Every example of it is identical in shape, fittings, and often in colour. This helps to get the car known, but acts as a deterrent to the class of purchaser who feels that he wants something a little bit different to that owned by other people.

It follows that if every motor manufacturer adopted this principle and marketed the complete standardised car, the motor coach-building industry, as a separate entity, would automatically become extinct or be absorbed by the motor manufacturers, its premises being utilised merely as subsidiary shops. Originality and progress in body design would be very much discouraged, and the man who takes a pride in the unique finish of his coach-work would no longer exist.

In view of all the facts, we may expect the cheap car, and the cheaper of the medium-priced cars, of the future to be offered almost invariably in the complete and fully equipped form. The pick of the medium-priced cars and the expensive cars may also be offered in one or more standard forms, but will continue to sell largely as chassis upon which the purchaser will fit a body built and finished in every detail to his taste and requirements. To the man who is anything of a connoisseur of motor cars, the "ready-for-the-road" principle stands condemned from the start, because, to take one example, it is obliged to assume that the legs of all motor drivers are of equal length. A man who ventures to fall below the standard length of leg allowed him by the car-maker is liable to find that he cannot reach his pedals with sufficient ease to facilitate their operation unless he sits on the edge of his seat and leaves his back without support. The motorist who has wilfully erred on the other side, and who is



A Leyland Salvage Vehicle fitted with a Crane and Tyre Press



A Guy Lorry with End-tipping body divided into Sections

DEVICES TO FACILITATE LOADING AND UNLOADING

too long in the leg, finds his knees interfering with his chin or impeding the operation of the steering wheel.

More often than not, the present day "ready-for-the-road" car is fitted with a body good enough from the point of view of general appearance when new, but not sufficiently accurately or strongly made to stand wear without the development of objectionable noises and bad fitting. Doors become either loose or jambed, and upholstery soon takes on a dilapidated appearance. As a rule, paintwork has been skimped, and reveals the fact after a little exposure. There are, of course, exceptions to every rule, but up to the present there is plenty of fault to be found with the body-work of the great majority of "ready-for-the-road" cars.

It must not be imagined that they stand alone in this respect. There are cars of the cheaper classes produced in comparatively small quantities and sold more or less complete, the bodies of which are open to every sort of criticism. Then, again, with the spread of the principle of marketing only fully equipped cars, a larger proportion of the group so marketed will undoubtedly be fitted with thoroughly well-built bodies. There is no possible reason why quantity production in respect of bodies should give other than satisfactory results. It need fail only by its inability to cater for the taste of each individual customer. To an extent this impedes quantity production of bodies to a greater degree than it interferes with quantity production of chassis. Plenty of cars are still sold on the appearance of their bodies, and people who are in no way qualified to criticise the chassis may be quite good judges of the comfort of a seat, or the beauty of a curve or of a colour.

The body-building shops forming a part of a big motor works may be devoted either to quantity production, or to the construction of individual bodies. The

transference of this business from the coachbuilder pure and simple to the motor manufacturer does not necessarily mean the elimination of individuality or hindrance or stagnation in respect of progress. It means merely that the ultimate relation of body to chassis will be more fully appreciated in the first instance by those concerned specifically with only one of the two structures.

The history of car bodies is a record of the gradual dawning of an appreciation of the fact that a motor car is essentially different from a horse-drawn vehicle. The first motor bodies were modelled on the old dog-cart, waggonette, brougham, and so on. They were ornate, and in many ways inconvenient and inefficient.

The car body of to-day is thoroughly simple in outline, destitute of unnecessary external adornment, and calculated really to afford the degree of protection which it professes to afford. The tendency of the moment is in the direction of bodies of the Cabriolet and " all-weather " types. By this is meant a body which on occasion can so far disappear from sight, as to leave what is apparently nothing more than an open touring car, but which in the event of wet weather or for night work can be rapidly raised, so that a completely covered car is formed. Obviously, the construction of such a body requires great care and the use of excellent materials. Failing either of these it will be unduly heavy, and the time will rapidly come when the body will grow noisy and leaky. The " all-weather " body is not a job for the lower class of coachbuilders, nor for the quantity-producing car manufacturer whose main object is low cost. If good results are to be obtained, expense must not be spared in the first instance. Nevertheless, the " all-weather " body may appeal very strongly to the motorist of strictly moderate means. It enables him, with only one chassis, to have,

to all intents and purposes, two distinct cars, one well suited to touring and fine weather work, and the other equally well suited to town and evening work and to travelling in wet and wintry weather.

Altogether, it does not at all follow that the motorist who wants a cheap chassis also wants the cheapest things in bodies and fittings. He may well think it worth while to pay something extra for a thoroughly efficient lighting dynamo, a really good adjustable wind-screen, or a type of glass that will not shatter and cause injuries in the event of an accident. For these and kindred reasons, the standardisation of the complete car may hang behind the standardisation of the chassis.

In the field of the industrial vehicle, similar arguments apply. Thus, in respect of passenger-carrying, varying conditions of service and class of customer may dictate very varying types of body-work. In the case of the motor char-à-banc, for instance, while one good type of chassis may be almost universally applicable, each purchaser has to consider what fares his clients are likely to be willing to pay, and what amount of space and luxury he can consequently afford to offer them. In the field of the goods-carrying vehicle, almost every trade has its own special requirements as regards body-work. Some, for example, deal in light and bulky goods for which large bodies are necessary. Others want bodies divided up into compartments or provided with shelves. Others require special facilities to accelerate loading and unloading. End-tipping bodies may fill some needs, while side-tipping bodies are better suited to others. Some may find it worth while to procure special devices, such as detachable bodies, or bodies that can be converted rapidly so as to serve two or three totally different purposes. Altogether, it would seem that, in the sphere of motor body building,

there will always remain plenty of room for the individualist, and that the coachbuilder who can excel in quality will continue to be able to hold his own. Meanwhile, in the cheaper class of work and all spheres in which standardisation is legitimate, the bulk of the business will be taken over by the motor manufacturer proper, and will quite cease to be handled by the comparatively small local coachbuilder.

CHAPTER XIX

THE PRESENT POSITION

The effects of the Great War have made themselves felt throughout the whole structure of the motor industry. In the first instance, the war caused a sudden dislocation due to the temporary but immediate extinction of some markets and the abnormal development of others. The ordinary everyday business of the industry was totally suspended in every one of the countries engaged in the war, and largely modified even in neutral countries. From the first, it was realised that motors would play a very important part, though it was not perhaps generally understood that they would prove to be one of the first essentials among munitions. Within a few months, the motor industries of all the countries engaged had been completely mobilised in the services of their respective governments. The production of a car, vehicle, or cycle for any other than government work became next door to impossible. The naval war and the demands for sea transport added to the difficulties and helped to extinguish the last remnants of export trade. Thus, the motor industry of Europe, regarded as a whole, found itself suddenly prohibited from making any use of the goodwill which it had accumulated in past years. In the meanwhile, it was at an advantage as compared with many other European industries, inasmuch as it was kept more than fully occupied upon work for which it was paid at a reasonable rate. Problems connected with the disposal of the whole of the projected output ceased for the time being to exist. Expenses incurred in connection

with selling dropped to an irreducible minimum. Consequently, payments made by governments, based upon pre-war prices, showed at first very substantial profits to manufacturers. As time went on, the cost of material and the cost of labour rose enormously, much more than counterbalancing the saving effected in sales organisation. Meanwhile, however, a high degree of standardisation in each individual factory had been ensured. Instead of producing several models, the manufacturer was concentrated upon one or, at most, upon two. His output of these particular models increased immensely, and the increase was further encouraged by the constant placing of new government orders necessitating enlargement of factories and the introduction of new machine tools. Thus, instead of a given output being divided up among five or six types, twice or three times that output was focussed on one type alone. Manufacturers were thus compelled to ascertain by experiment the result of adopting the one-model policy, and they found the influence of the change so favourable that, despite the immense rise in the price of material and labour, they were in general able to continue to supply their governments at the prices originally fixed, and to make satisfactory profits on the transactions.

Up to this point, it would seem that the motor industry had no grounds for complaint. It must be remembered, however, that, though sales to government might be profitable, they were also compulsory and consumed the entire output. Moreover, special taxation of profits in excess of those made prior to the war had the effect of reducing possible dividends to normal dimensions, and preventing the accumulation of large reserves. It is necessary to distinguish clearly between liquid assets and assets represented by enlarged

buildings and new plant. The latter are not, like the former, available for purposes of current expenditure. They cannot be applied to the perfecting or enlargement of a selling organisation, to a big scheme of publicity, or in any way directly or indirectly towards the paramount object of regaining and maintaining goodwill.

A very widespread misconception on the part of the public as to the war-time position of the European motor industry is due primarily to the fact that the value of goodwill is very difficult to assess exactly, and is consequently apt to be left out of account altogether. To take a simple example, if a certain business transaction shows a cash profit of £1,000 and leads to the loss of goodwill to the extent of £1,200, then that transaction is inherently a bad one. While the European motor industry was making apparent profits by the sale of the whole of its enlarged output to the various governments, its established goodwill was being automatically reduced in value, and, worse still, was not merely sinking out of existence, but was passing into the hands of the industries of competitive firms. Thus, the European industry came face to face with a very difficult after-war problem. Without any considerable accumulation of liquid assets, it had to find enlarged markets for its enlarged outputs, and in order to do so it had first to solve the problem of how to regain goodwill which had been transferred into the hands of very active and able competitors. It is much more difficult and costly to accumulate goodwill at the expense of an able opponent who already has it in his possession, than to build it up in competition with others who must themselves start from the same point.

It must be remembered, too, that the motor industries of temporarily neutral countries were, as the result of the war, flooded with orders on favourable terms. The

profits thus accruing were not in their case liable to excessive taxation, since their governments were not involved in the prodigious expenditure inseparable from modern warfare.

Let us endeavour to make the position clear by means of a typical illustration. For this purpose, we will take a British manufacturer who, before the war, had sold his output through agents in all parts of the world, and a neutral manufacturer who, before the war, had catered mainly for his home market, but who was looking for opportunities of extending his business and disposing of his surplus output. The agents of the British firm, finding that their principal was prohibited from supplying them with any more new vehicles, were compelled to look about for a means of livelihood. They must either sell something or shut up shop. At this juncture along comes the neutral manufacturer anxious to appoint good agents, and able to deliver cars. The result is inevitable. The agent changes his allegiance from the British to the neutral firm. He uses his established connection, built up largely on the merits of the British car, as a means of introducing the neutral one. If the latter is any good at all, and if its makers offer the agent favourable terms and conditions, a permanent relationship is presently formed ; and when the British manufacturer, able once more to build cars for the public, appeals again to this agent to help him, he finds himself in negotiation with a man who is deeply involved in business connections with another manufacturer, and is very unwilling to take a second time the risks involved in any considerable change in his scheme of business. The agent has lost touch very largely with the class of customer on whom the British manufacturer mainly depends, and has cultivated the class to which the other car is likely to appeal. He has, in

fact, built up for himself a new goodwill and connection, and he is not going to throw this overboard in the interests of the goodwill of the British manufacturer unless some very strong monetary inducement is offered to him.

Even if the agent be willing to do his best to re-establish the local market of the British manufacturing firm, he has difficulty in doing so. Deliveries for a time at least are likely to be uncertain and unpunctual, and the new models offered have in most instances not proved themselves in public. Their manufacturer is for the time hampered by the necessity for re-organising his whole system, reverting from munitions to motor cars. In doing so, he finds that while the machinery that he has put in is excellent for its own special purpose, and no doubt well adapted to deal with certain parts of his business as a producer of motor cars, it is badly balanced. In other words, it is suitable for producing some motor car parts in much greater proportional quantities than others. Consequently, to get things on a proper manufacturing basis, yet more new machinery must be purchased. It is no good to be capable of producing some components of the complete car in huge quantities if one's works are able only to produce other components in comparatively small quantities. The rapidity of production of each component part must be right in relation to all the others, so that all the parts of a complete car take the same time to produce.

Meanwhile, the British manufacturer also has to deal with big changes in respect of labour. Jobs must be found for men who are coming back, and probably men and women who have for some time been employed must be dispensed with for one reason or another. Thus, even the most perfect handling cannot in a moment

produce perfect system during the period of re-construction and re-arrangement. Elsewhere, manufacturers, on the other hand, have been able to concentrate attention on this difficult period, and so to ensure that when free competition comes again they will be able to show up at an advantage. This advantage is not noticeable only in respect of manufacture. Any manufacturer who has been involved in the war only for a comparatively short period has almost certainly accumulated very large reserves. These can be applied to a price-cutting war, or to the organisation of a comprehensive sales and publicity department, bringing it closely into touch with all the world's markets.

Thus, while the European motor industry may have been fortunate as compared with certain other European industries during the war, its relative strength as against other motor industries has been very much weakened. In the struggle for supremacy, this is what really matters. The man with a few thousand pounds of capital may be fortunate when we compare him with the man who possesses no capital at all. If the two were engaged in one industry, he would undoubtedly have the advantage and the better future prospects. It is equally true that, as against the man who can speculate in millions, the small capitalist has hardly any chance. Thus, it is poor consolation to the European motor industry to know that some of its neighbours are in even worse plight, if, with small reserves and shorn of its goodwill, it finds itself face to face with a competitive industry that has been presented with most of the goodwill of all the world's markets and has an immense accumulation of capital available for the maintenance thereof.

These considerations give us a fairly clear idea of the present position. The war has taught the European

motor industry the advantages of quantity production so far as the method may be applicable in view of the extent of the available markets. It has also taught the art of constructing machines to stand up under the roughest conditions of service, even when the facilities for repair and maintenance are somewhat restricted. All other manufacturers have, in the war, been taught these lessons, so far as they required to know them, almost equally well. They have also enjoyed the immense advantage of being permitted to accumulate funds and being free to conserve their markets and goodwill, and to take over the markets and goodwill of the European industry. Consequently, at the moment, the latter is in a precarious position, and in the next and concluding chapter we propose to deal briefly with the steps that must apparently be taken if the national motor industries of European countries are to be rendered permanently strong. We shall also endeavour to sum up the reasons why a strong national industry must henceforth be essential to every great country.

CHAPTER XX

THE FUTURE OF THE INDUSTRY

A STUDY of the future of the motor industry is, at the time of writing, rendered somewhat difficult owing to the abnormal circumstances now prevailing, coupled with the fact that the position is changing daily, and that what are now only contingencies may in a few weeks or months be features of established national policy. From the last chapter it will have been gathered that the main question as to the future is the degree to which the handicap inflicted on the industries of nations which have taken part in the Great War from its early stages may prevent equal competition with those who have remained neutral during the whole or the greater part of the struggle. We need not concern ourselves here with the industries of Germany and her Allies. Neither need we at this juncture deal directly with the industry of the United States, since the motor manufacturers of that country are, comparatively speaking, in a very fortunate position. This is due partly to the circumstances detailed in the last chapter, and partly to the fact that the States have been the first to develop the principles of standardisation and quantity production and combination. The motor market of the United States is enormous, even if we disregard export trade. This market has from the very first been created into a preserve for the American manufacturer by the erection round it of a high tariff wall. Under existing circumstances, it is doubtful whether the American

industry would suffer very severely if this protection were removed, since it is now so strongly established, and so thoroughly capable of meeting all competition in the matter of price. It was during its earlier stages that the tariff exercised its greatest influence. It then prevented European cars, undoubtedly of higher quality than those manufactured in the United States, from entering the American market except under the handicap of immensely inflated prices. The home industry was thereby enabled to grow up with the sure knowledge that, when it planned expansion, it might be certain of its ability to dispose of a properly estimated output based on the national demand for motors. It was not liable to have that demand cut in half by the sudden arrival of competitive foreign goods in large quantities.

There are those who believe that, even if the Great War had not intervened, the expansion of the American motor industry would still have brought about in a very few years the almost total extinction of the European industry. Any tendency that may have existed in that direction has been greatly accentuated by the war, and we may now take it for granted that no national industry has much chance against that of the United States, unless it can provide itself with very considerable markets adequately protected. At the time of writing, the main item of the programme of the British motor manufacturer in that respect consists of an advocacy of a system of tariffs to apply for at least five years after the war. This system would provide the highest preference for all goods manufactured within the British Empire, a secondary preference for the goods of Allied countries, somewhat substantial duties against the goods of countries that had not suffered in the same degree from the war, and a prohibition or prohibitive

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tariff against the products of Germany and other enemy countries. However far British manufacturers may find it possible to carry the principles of standardisation and quantity production in the near future, it is in the opinion of the writer impossible for the industry to enjoy a reasonable degree of security and opportunity for development, unless it is assisted by a system of adequate tariffs.

From this it must not be gathered that the policy of the British motor industry is merely a policy of protection. The industry does not only look to the government to help it, but intends very seriously setting about the work of helping itself by the adoption of the best possible methods in view of its circumstances and by scrapping the old principle of total individualism. Then, again, the stated policy of the industry favours a thorough re-organisation of the governmental commercial service both in the Empire Overseas and in foreign countries. It is felt that in the past the close relation of commerce to foreign policy has not been properly appreciated, and the latter has been regarded as something just a little sordid and not worthy of the attention of the best stamp of man. It is now realised that the principal commercial official in every big Overseas centre must be a man whose official and social standing is almost, if not quite, equal to that of an ambassador. This man must have at his disposal the means of perfecting a really strong organisation of commercial experts occupying Consular positions, but able to devote the whole and not merely a small part of their time to the advancement of British commerce and industrial interests. Officials of this sort should be properly paid, so that really good business men should be attracted to occupy the positions. Foreigners should not be employed in any such capacity.

There is a somewhat widespread feeling to the effect that proper re-organisation in these respects can result only from the formation of a distinct Ministry of Industry and Commerce, and not from any internal changes that could be effected within existing Government Departments.

Then, again, British motor manufacturers feel that their future prosperity is largely dependent on the existence of commercial banks so constituted as to be much better able and willing to give financial help in respect of reasonable efforts to extend markets, to obtain large foreign contracts, or to acquiesce in the terms of credit required by traders in many foreign countries. In this way, it is felt that other nations might well borrow from the experience of Germany. In the past, through the medium of their own banks which have dealt with German trade banks, British manufacturers have most certainly given their unwilling assistance to their German competitors, while they themselves have not been able to obtain from British banks assistance comparable in quality or in quantity. Many other measures are suggested, any of which would contribute towards the desired result.

Given hearty Government support, the British industry and the industries of the countries allied to Britain in the war should have a great future before them. They are well supplied with brains both from the technical engineering, and from the business standpoint. They are showing themselves willing to adopt new methods, and they long ago proved themselves capable of achieving great feats as regards perfection of design and manufacture. They have plenty of originality and plenty of enterprise. In the past, they have lacked full appreciation of the advantages of quantity output and standardisation, but they have

probably been wise in refusing to embark upon direct competition with the United States under the permanent handicap of much smaller and less certain markets. The British industry in particular, and others in a lesser degree, have lacked wholehearted sympathy in Government quarters. Nothing that can be done by manufacturers themselves can adequately safeguard the future unless such sympathy exists and takes a practical form.

The actions of a government depend, or are supposed to depend, primarily upon public opinion, and in the case under consideration public opinion in turn depends largely on whether it is clearly realised that a strong national motor industry is an essential. If this could not be proved, the British and other industries would probably be left to fight their own way without help, and the result would certainly be failure.

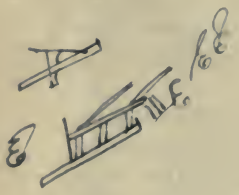
A strong national motor industry is, however, most certainly essential, for at least three reasons. As to the first of these we have recent proof of the fact that modern warfare cannot be waged without the support of an immense number of motors. No one would be so foolhardy as to suggest that in any future wars full dependence should be placed on sea-borne supplies from neutral countries. Thus, any combatant may be placed in a position in which his ability to carry on war becomes entirely dependent on his ability to produce good motor vehicles.

Secondly, it is not sufficient that the national industry should be capable of producing only as many motor vehicles as could conceivably be required in case of war. Its aggregate output must be much larger. This is due partly to its natural relationship with the aircraft industry, which must always in time of war be abnormally extended. The motor industry forms its natural

reinforcement, and must be able to transfer a fair percentage of its energies to aircraft work while still producing adequate supplies of its more normal products. Moreover, the motor industry is the finest of all training grounds for skilled mechanics. Its men are taught to produce work possessing a very high degree of accuracy. If the national motor industry is excessive from the point of view only of the necessary supply of motors in war time, then it is a valuable national asset to be able to take from that industry large numbers of skilled men and apply them to the production of munitions of war of all other sorts.

Up to this point, our argument as to the essential character of the industry is based mainly on the possibilities of war. Even if those possibilities were eliminated, our general conclusion remains the same, because the internal commerce of a made country, or the development of a new country, depends simply and solely on the creation of means of communication. The motor vehicle has already become, or is rapidly becoming, indispensable in connection with every sphere of commercial activity. For the carriage of raw materials, and for the delivery of goods alike, it represents a vast improvement as regards both speed and economy when compared with animal traffic. It is complementary to our railways and our steamship lines. It affords the only means of dealing with the heavy road traffic that steadily increases in aggregate bulk in the central areas of towns. By using the roads to greater effect, it prevents congestion, and at least delays the necessity for incurring expenditure on road widening. In fact, a little thought will serve to show any of us how dependent we have now become upon the products of the motor industry, and how necessary it is that any country which desires or professes to excel or compete in

commerce shall, by maintaining a strong motor industry of its own, ensure that it shall not be dependent upon the outer world for what cannot be regarded as other than one of the great essentials of national organisation along modern and competitive lines.



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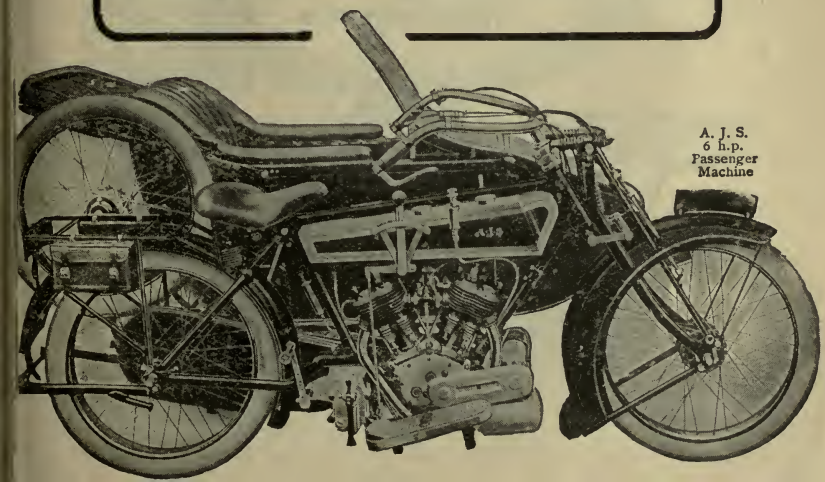

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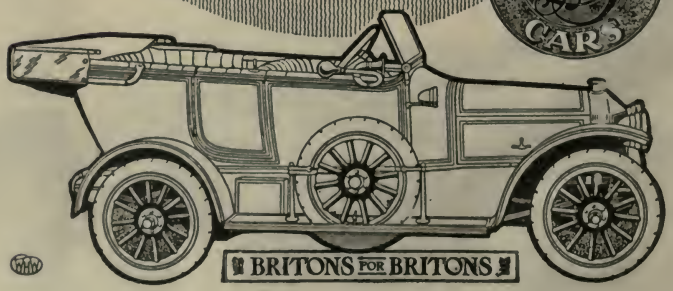

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